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THE NATURALIST

Quarterly Journal of Natural History for the North of England

Edited by M. R. D. SEAWARD, MSc, PhD, DSc, FLS, The University, Bradford

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THE OCCURRENCE OF *LITTORINA* SPP. IN ROBIN HOOD'S BAY, NORTH YORKSHIRE, WITH A KEY TO BRITISH SPECIES

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INTRODUCTION

The winkles (genus *Littorina*) are among the commonest and most familiar snails of our rocky shores, yet for the past fifteen years species indentification has been complicated by extensive taxonomic reorganisation of some species groups. There is no guarantee that further alterations will not be made, but, at the moment, a reasonable consensus exists as to the number of British species. Of the eight species now thought to occur in Britain seven are to be found in Robin Hood's Bay (Fig. 1). The purpose of this paper is to outline the changes in taxonomy which have occurred, to provide a key to the British species and to describe the varieties of these found in Robin Hood's Bay with some notes on their natural history. Since most of the previous work was carried out in S.W. England and Wales, I felt observations from Yorkshire would be of interest, and of more direct use to local naturalists.

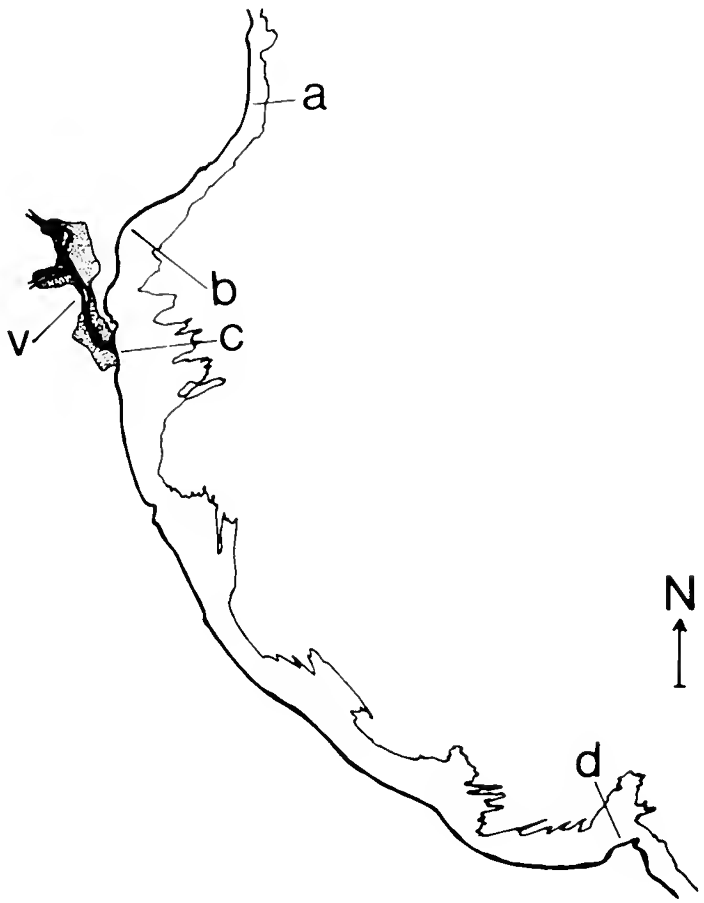

Fig. 1. Map of Robin Hood's Bay, N. Yorkshire; bold line giving the position of the cliff edge and fainter line illustrating the level of low water (spring tides). Locations: a) North Cheek, b) site of boulder populations of *L. rudis*, c) sea wall of former marine laboratory, d) South Cheek below Ravenscar, v) Robin Hood's Bay village. N represents due north.

Taxonomic revisions 1966–1983

In the fifty years up to 1966 only four species of *Littorina* were recognised on our coasts; *L. littorea* (L.), *L. neritoides* (L.), *L. littoralis* (L.) and *L. saxatilis* (Olivi). In 1966 Sacchi and Rastelli revised the taxonomy of *L. littoralis* establishing two British species; *L. obtusata* (L.) and a new species *L. mariae*. Subsequent work has served to support this division (Goodwin and Fish, 1977) and no attempt to split these species further has gained much credence. James (1968) considered *L. saxatilis* to consist of six subspecies with twelve varieties, sparking off a decade of controversy in which it became clear that this 'species' was, in fact, an aggregate of several species. Heller (1975) divided in into four; *L. rudis* (Maton), *L. neglecta* Bean, *L. nigrolineata* Gray and *L. patula* Thorpe. Later, evidence was presented to show that *L. patula* was synonymous with *L. rudis* (Raffaelli 1979, Hannaford Ellis 1979), but Hannaford Ellis (1978, 1979) described a new species within this complex, *L. arcana*. It is probable that *L. rudis* should revert to the older synonym *L. saxatilis* unless the two can be shown to be separate species as suggested by Smith (1981). This will, however, not help to dispel lingering clouds of confusion. The existence of another species *L. tenebrosa* (Montagu) has not been adequately demonstrated. For a detailed review of the taxonomy and recent work on this group the reader should consult Fretter and Graham (1980) and Raffaelli (1982).

Key

The identification of these species is not difficult but may require dissection. Some characters used require familiarity before divisions become clear, although Fig. 2 and Fig. 3 may help initially. The key makes no attempt to reflect phylogeny and is only intended to be used for sexually mature adult snails, as indicated by the presence of a penis in the male and an oviduct below the rectum in the female. *L. nigrolineata* is not, as yet, recorded from the Yorkshire coast.

1. Shell with pointed spire (Fig. 2 a, d, e, f) 2

   Shell without spire, apex flat or nearly so (Fig. 2 b, c) 7

2. Outer lip of aperture meets body whorl at acute angle (Fig. 2 a) 3

   Outer lip of aperture rounded, meeting body whorl nearly at a right angle (Fig. 2 d, e, f) .. 4

3. Usually under 6mm in height, shell grey and unpatterned; inside of aperture glossy black or brown; characteristically a flap of periostracum, the thin proteinaceous outer layer of the shell, extends beyond the aperture lip. Tentacles not banded. Typically at the extreme upper fringe of littoral zone on cliffs or large boulders. *L. neritoides*

   Adults over 1cm in height, shell grey, black or brown frequently with faint spiral lines, columnar lip of aperture white and outer lip often striped internally. Tentacles banded. Widely distributed on shore, not on cliffs. *L. littorea*

4. Shell rather globose. Small, being adult at 4mm in height or less. Usually associated with barnacles in the mid and upper shore. Frequently with a black band round the base of the shell. *L. neglecta*

   Shell not globose, being more acutely spired. Never mature below 5mm in height. 5

5. Shell with distinctive sculpture consisting of many flat-topped ridges around three times the width of the intervening grooves which frequently contain a black pigment. *L. nigrolineata*

   Shell often, but not always ridged. Ridges, except on base, pointed and not wider than grooves. 6

6. Females possess a brood pouch and brood young. Both sexes have a large patch of pinkish cilia between the end of the gut and the columellar muscle (Fig. 3 a. b). (The variety *tenebrosa* will also key out here). *L. rudis*

   Females possess a large opaque white jelly gland in place of a brood pouch (Fig. 3 c). Ciliated area, if present, extending very little below gut. *L. arcana*

7. Penis with extended tip and one row of penial glands. In Yorkshire; aperture lip very thick and apex flat (Fig. 2 b). *L. mariae*

   Penis with short tip and two to three poorly defined rows of penial glands. In Yorkshire, aperture lip not greatly thickened and apex slightly raised (Fig. 2c). *L. obtusata*

Occurrence in Robin Hood's Bay

1. *L. neritoides* (Linnaeus, 1758); 'small periwinkle'
   This species is not common due to the friable nature of the cliffs depriving it of its habitat. It does occur in small numbers on the sea walls of the Bay Hotel and former marine laboratory and on the cliffs at North Cheek and Ravenscar.

2. *L. littorea* (Linnaeus, 1758); 'edible winkle'
   This is a common species of rocky shores in this area where it is extensively collected for food. It occurs over most of the tidal range, sometimes in dense aggregations. Shells of juvenile specimens, below 5 mm in height, are uniform pale grey with coarse ridges but can be distinguished from *L. rudis* and *L. arcana* by the slightly concave-sided appearance of the spire, and when larger by the black and white banding of the aperture lip. The adults are not usually ridged, and on the lower shore can reach shell heights of 3 cm, much larger than any other species. A distinctive orange-red morph of this species occurs at low frequencies on Yorkshire coasts.

3. *L. obtusata* (Linnaeus, 1758) and *L. mariae* Sacchi and Rastelli, 1966; 'smooth winkles'
   Both species are common among fucoid weeds over most of the shore. *L. obtusata*, however, occurs higher up amongst *Fucus vesiculosus* and *Ascophyllum nodosum* whereas *L. mariae* is found lower down on *F. serratus*. In the former species the predominant shell morph is dark green and the aperture is not greatly thickened, whereas the latter is mostly of a tesselated brown variety and the shell is greatly thickened giving a comparatively smaller aperture. Some authors use the pigmentation of the ovipositor as an identification character (Goodwin & Fish, 1977) but this has not proved useful for Yorkshire specimens (J. Grahame, pers. comm.).

4. *L. neglecta* Bean, 1844
   Distinguished mainly by its small adult size, this species is abundant amongst the barnacle *Semibalanus balanoides* on the mid and upper shore, often inhabiting empty barnacle shells. but it is rare on sea walls and cliffs. The shells can be plain black, banded or tesselated. The females are ovoviviparous and possess brood pouches.

5. *L. rudis* (Maton, 1797) and *L. arcana* Hannaford Ellis, 1978; 'rough winkles'.
   L. rudis is not a common species within the bay, being abundant only amongst boulders at Ravenscar, where it co-exists with *L. arcana*. Small populations also exist amongst boulders at the base of cliffs to the north of the village where *L. arcana* is extremely rare. Some of these boulder populations have purplish-grey shells but others have orange and brown striped shells, a variety not shown by *L. arcana* in this area. Populations of rough winkles on the sea walls of the Bay Hotel and former marine laboratory have been found to consist entirely of *L. arcana*. These animals have thinner shells with wider apertures than the boulder *L. rudis* but where the two species co-occur at Ravenscar the shells are indistinguishable (Fig. 2 d. e. f). *L. rudis* broods young while *L. arcana* lays egg-masses.

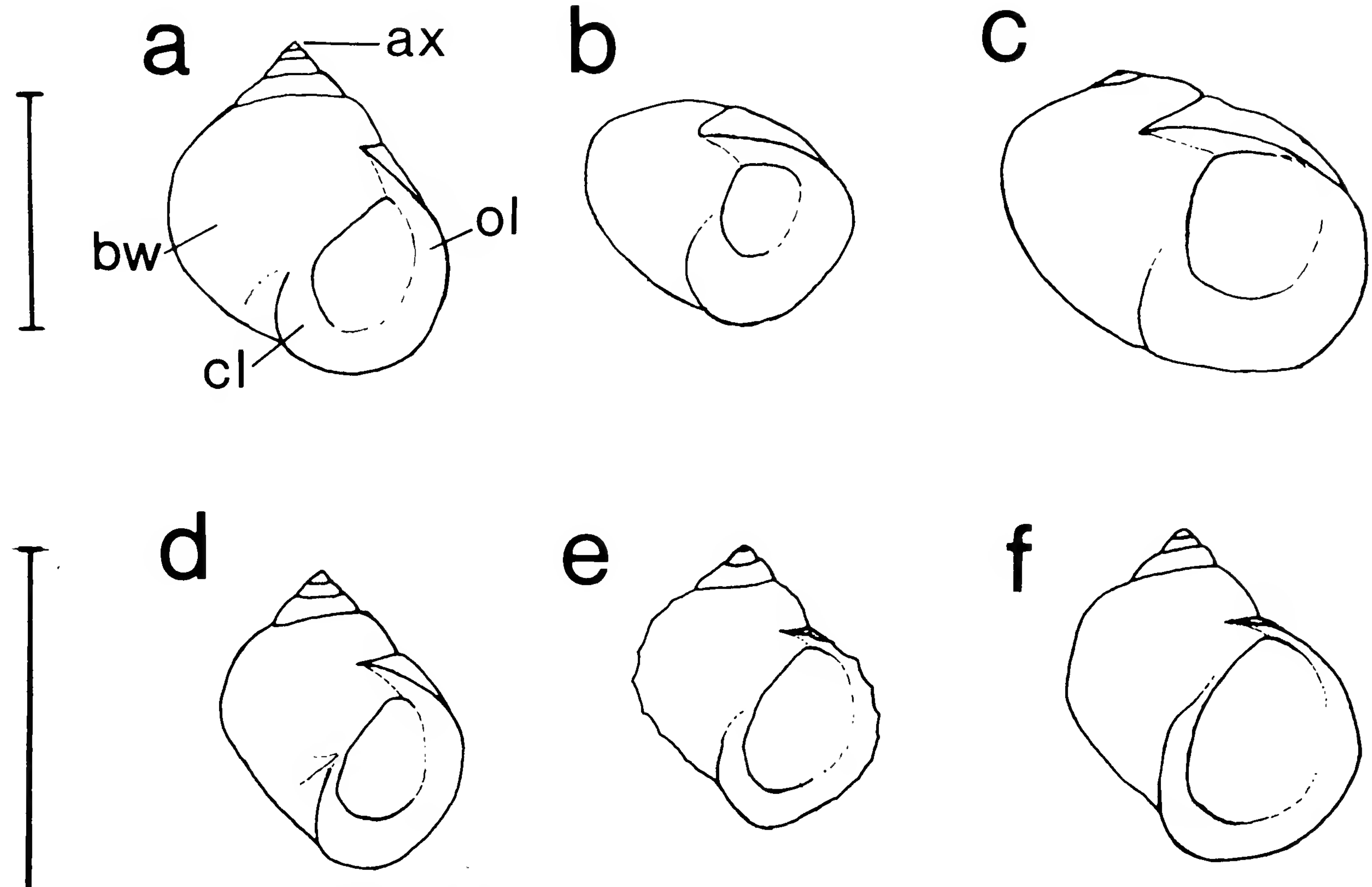

Fig. 2. Shells of specimens from Robin Hood's Bay. a) *L. littorea.* Labels: ax) apex of spire, bw) body whorl, cl) columellar lip of aperture, ol) outer lip of aperture. b) *L. mariae,* showing flat apex, no spire. c) *L. obtusata,* showing slightly raised apex. d) *L. rudis* from location b, Fig. 1, illustrating the narrow aperture typical of boulder sites. e) *L. arcana* from Ravenscar where the shells are indistinguishable from those of *L. rudis.* f) *L. arcana* from location c, Fig. 1, illustrating the wide aperture typical of more exposed localities e.g. cliffs and sea walls. **Both scale bars represent 1 cm and refer to the three shells illustrated in the same row.**

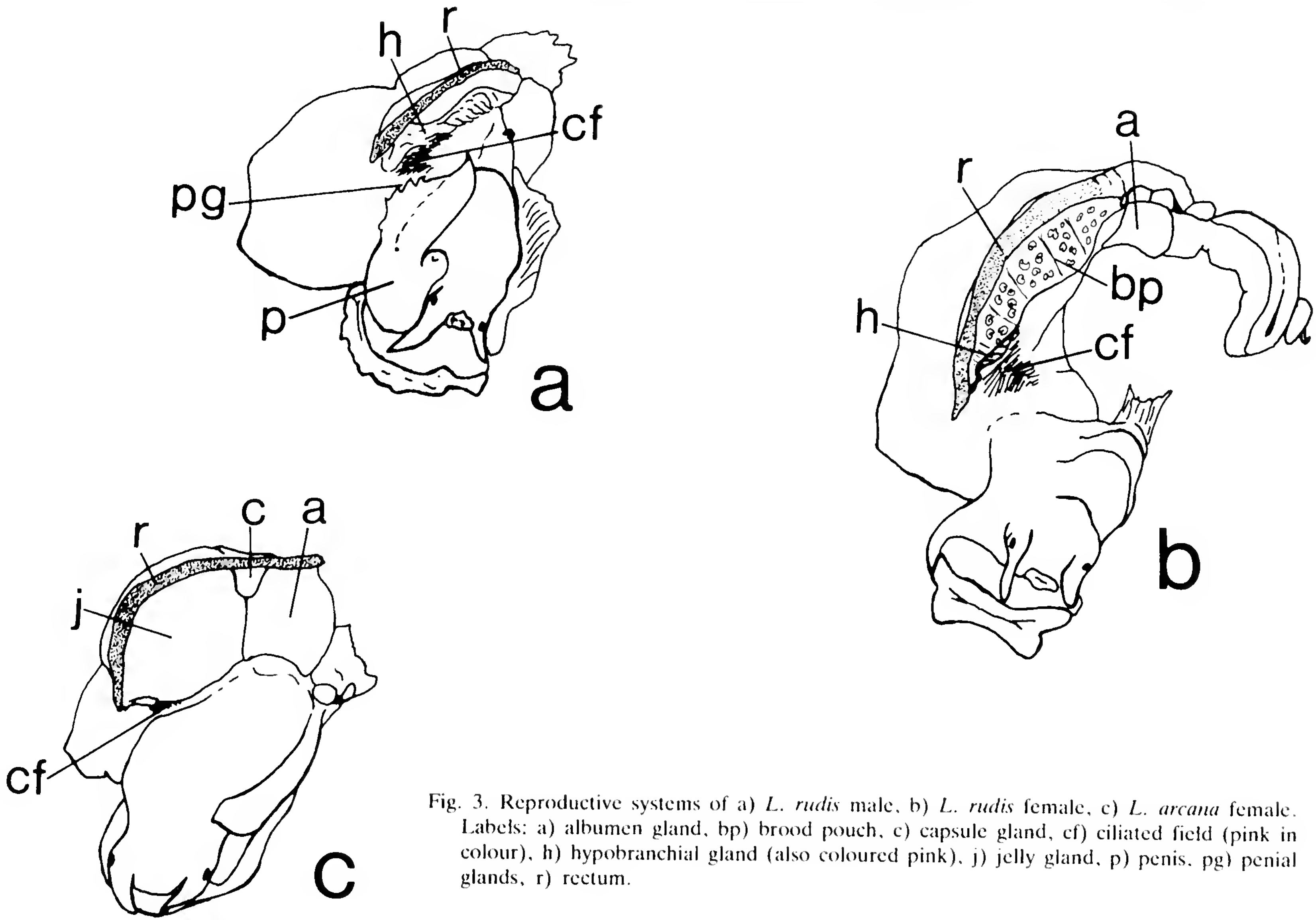

Fig. 3. Reproductive systems of a) *L. rudis* male, b) *L. rudis* female, c) *L. arcana* female. Labels: a) albumen gland, bp) brood pouch, c) capsule gland, cf) ciliated field (pink in colour), h) hypobranchial gland (also coloured pink), j) jelly gland, p) penis, pg) penial glands, r) rectum.

Due to the nature of the sea-walls the eggs are difficult to find but three egg masses were found in April 1982. On collection one of these egg masses consisted of eggs showing no signs of development and were presumably recently laid. These took 40-50 days to hatch at a temperature of 10°C, and the young hatched at a shell diameter of ·5 mm.

The use of the ciliated field for identification was introduced by Hannaford Ellis (1979). This has proved quite a reliable character in Robin Hood's Bay. Fig. 4 shows the variability of the relationship between the width of the field and shell height for males of these species in this area. It shows that some specimens, particularly small ones, may prove difficult to identify with certainty. Differences in the penis shape described by Hannaford Ellis (1979) do not seem to hold true for Yorkshire specimens.

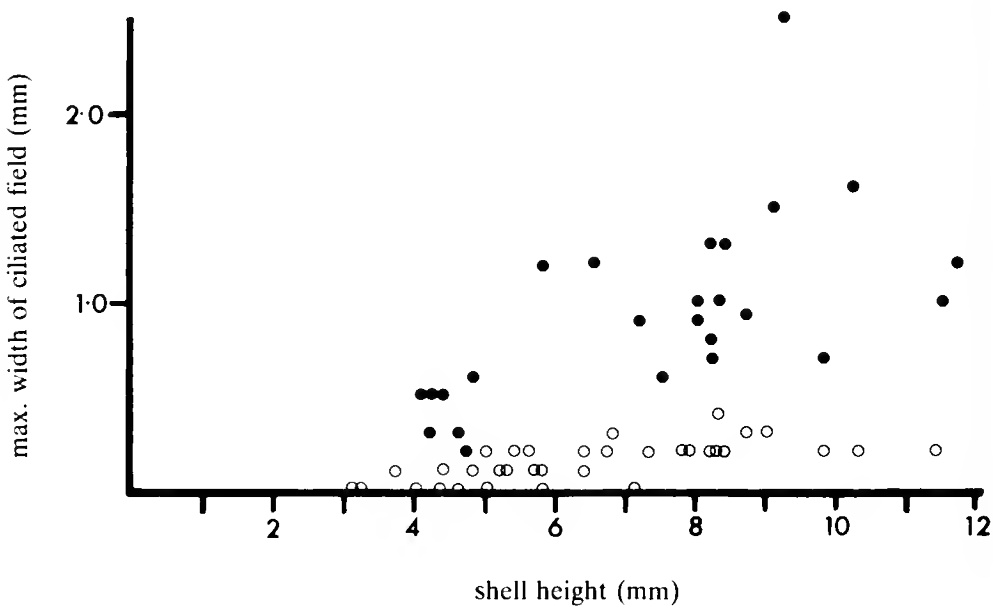

Fig. 4. Relationship between shell height and width of ciliated field for male and juvenile *L. rudis* (from location b, Fig. 1) and *L. arcana* (from location c, Fig. 1), showing the variability of this characteristic. Closed circles represent *L. rudis* and open circles *L. arcana.*

ACKNOWLEDGEMENTS

I would like to thank Dr John Grahame for his help and advice, Professor R. McN. Alexander and Dr J. R. Lewis for providing facilities to carry out the work.

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MARCHESINIA MACKAII AND OTHER NOTTINGHAMSHIRE BRYOPHYTES

T. L. BLOCKEEL

20 Heathfield Close, Bingley, W. Yorks BD16 4EQ

The bryology of Nottinghamshire (VC 56) has received very inadequate attention in recent years: Pearman, in his list of bryophyte county literature (Pearman, 1979), could give no references for the county. After the British Bryological Society meeting in Nottingham in September 1982, I therefore took the opportunity to bryologize at a few sites on the western side of the county.

Creswell Crags form an open gorge on the magnesian limestone on the Nottingham/Derby border. The flora is reminiscent of similar sites in South Yorkshire, notably at Roche Abbey and Anston Stones Wood. Though wooded, Creswell Crags are less sheltered than these Yorkshire sites and the flora is somewhat less luxuriant. The following species were seen on limestone outcrops on the Nottinghamshire side, some being present in small quantity only: *Anomodon viticulosus, Barbula revoluta, B. rigidula, B. vinealis. Brachythecium populeum, Cirriphyllum crassinervium, Eucladium verticillatum, Fissidens cristatus, F. pusillus* var. *tenuifolius, Neckera complanata, N. crispa, Plagiomnium cuspidatum, Rhynchostegiella tenella, Taxiphyllum wissgrillii, Tortella tortuosa, Tortula marginata, Trichostomum brachydontium, Metzgeria furcata, Apometzgeria pubescens,* and *Marchesinia mackaii*. On the soil among the rocks were *Pottia intermedia* and *P. recta*, and in an old quarry behind the Crags *Ditrichum flexicaule. Encalypta streptocarpa* and *Homalothecium lutescens*. The occurrence of *Marchesinia mackaii* at Creswell Crags is particularly interesting in view of its recent discovery at Anston Stones Wood (Blockeel, 1979), and suggests that its distribution in central and eastern England is limited more by a lack of suitable habitats than by climatic factors. Only one small patch was seen on the crags. Nearby at Tile Kiln Wood near Welbeck deciduous woodland had *Thamnobryum alopecurum* and *Plagiochila asplenioides s. str.* among the ground flora and *Bryum flaccidum* as an epiphyte.

The Coal Measures at High Park Wood near Eastwood gave rise to a calcifuge flora of a predictably limited nature. *Plagiothecium curvifolium* was on rotting wood and *Dicranum tauricum* on a fallen willow at the upper end of the reservoir. Rather more surprising was a little *Homalia trichomanoides* on a tree base by the small stream. Ruderal species included *Bryum microerythrocarpum* in an arable field and *B. ruderale* by a track side.

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BOOK REVIEWS

Adam Sedgwick — Geologist and Dalesman 1785–1873: a biography in twelve themes by **Colin Speakman**. Pp. xii + 145 (including 20 illustrations). Broad Oak Press (Heathfield, East Sussex), Geological Society of London, and Trinity College, Cambridge. 1982. £5.75 paperback.

The cover of this book, showing some fine Yorkshire Dales scenery, the dedication to Dr Arthur Raistrick and the known attachment of the author to the Dales leave one in little doubt that this book is as much a biography of a Dalesman as of a geologist. Indeed, Speakman's main argument is that the key to Adam Sedgwick, born in Dent and professor of geology at Cambridge University from 1818 to 1873, was that he remained a Dalesman at heart.

This approach has strengths and weaknesses. Speakman writes engagingly about Sedgwick's childhood in Dentdale and is always alive to those connections which Sedgwick maintained with his native area. Yet even this reviewer, born, bred, and still resident in the West Riding of Yorkshire, jibs at some of the author's exaggerated claims. Though one welcomes the attention given to John Dawson, the Garsdale mathematician who befriended the young Sedgwick, it is difficult to accept that Sedgwick spent the rest of his life trying to live up to Dawson's personal standards. There was clearly more to Sedgwick's Whig politics at Cambridge than his early experience of Dent democracy. To see Sedgwick as a distant father of the Countryside Holidays Association is rather ludicrous. Speakman criticizes the huge Victorian *Life and Letters of Adam Sedgwick*, edited by Clark and Hughes, for its hagiography, yet he commits the same solecism.

The author's excesses stem from his enthusiasm and not from ignorance. Drawing on Clark and Hughes, on good modern secondary sources, and on Sedgwick's own publications and manuscripts, he has written an attractive, intelligent, and popular book, which contains many nice aperçus. One of his best chapters deals with the controversy between Sedgwick and Murchison about the relation between the Cambrian and Silurian geological systems. Here Speakman forgets his Dalesman thesis and rightly sees how a property dispute was based on different methodologies, Sedgwick placing far more emphasis than Murchison on superposition and lithology.

This biography is an enjoyable book about a Dalesman who was also a 'professional Yorkshireman' on the academic and ecclesiastical make in East Anglia. It is good to have it three years before the bicentenary of the birth of Sedgwick, who was rightly regarded by his contemporaries as 'the first of men'.

JBM

Atlas of the Lichens of the British Isles, Vol. 1. edited by **M. R. D. Seaward** and **C. J. B. Hitch**. Pp. 189, including 178 maps. Institute of Terrestrial Ecology, NERC. £4.50.

Distribution maps are presented on a 10 × 10 km square grid for the whole of Britain and Ireland. After twenty years of careful recording by members of the British Lichen Society and intense searching of herbaria and published records by a few dedicated members there are over 100,000 records for the 700 or so taxa of British lichens now held on computer in Bradford.

In spite of this concerted effort the work is far from over and many species and areas are under-recorded. This, combined with the unwieldiness and expense of a volume of 700 'hand-spotted' maps, led to the selection of 176 species for inclusion in volume 1. Many of these are well known species or show interesting distribution patterns. The footnotes to the maps discuss such features and provide additional information, for example on habitats occupied in different parts of the country.

Air pollution and recording intensity are given in two additional maps in the introduction showing areas with high levels of sulphur dioxide and grid squares with more than 100, 5–100 and less than 5 records. This enables these important influences on mapped distribution to be borne in mind when interpreting the maps. They should be especially useful to anyone interested in local flora, phytogeography or conservation, and provide an excellent baseline from which the effects of changing habitats and air pollution levels can be studied.

ARC

SIX SPECIES OF *MEGASELIA* (DIPTERA, PHORIDAE) FROM NORTHERN ENGLAND, NEW TO BRITAIN, AND INCLUDING TWO NEW TO SCIENCE

R. H. L. DISNEY

Malham Tarn Field Centre, Settle, North Yorkshire

Volume I of my *Handbook* on British Scuttle Flies (Phoridae) (Disney, 1983a), dealt with the ninety-three species in genera other than the giant genus *Megaselia*. Volume II will deal with about 200 species of *Megaselia* Rondani. The present paper records six species in the North of England which are new to the British List, including two new to science.

Megaselia clemonsi n. sp. (Figs. 1 and 3)

Type locality
England: Murston, Kent.

Type material
Holotype: ♂, Murston, Kent (Grid ref. 51/922646) 8 May 1982. Leg. L. Clemons, in coll. Disney. Paratypes: 1♀, same data as holotype; 1♂ Sike Wood, Ripon Parks, N. Yorkshire (Grid ref. 44/307744) 6/8 May 1981, R. H. L. Disney; 1 ♂, Highscree Wood, Malham Tarn, N. Yorkshire (Grid ref. 34/894673) 17/18 April 1983, R. H. L. Disney; 1 ♂, Ferry House, Lake Windermere, Cumbria (Grid ref. 34/3995) April 1981, leg. C. M. Drake; 1 ♂, Hayley Wood, Cambridgeshire (Grid ref. 52/2953) 31 June/15 July 1980, leg. D. M. Unwin; 1 ♂, Flatford Mill, Suffolk (Grid ref. 62/079330) 15/17 August 1981, R. H. L. Disney; 1 ♂, Runnymede Meadow, Surrey (Grid ref. 51/0172) 7 August 1980, leg. P. J. Chandler; all in coll. Disney.

Etymology
The species is named after Laurence Clemons, who collected the holotype and the only female recognized so far.

Description
MALE. HEAD: Frons dark with 60–80 hairs. Upper supra-antennal bristles longer and more robust than lower pair and a little closer together than preocellars. Antero-laterals more-or-less level with upper SA's. Antials a little lower and midway between these bristles, or a little closer to antero-laterals. Antennae and arista brown. Segment 3 of antenna with some longer hairs, with curved-over tips, protruding from the denser pile distally. Palps yellow to dusky yellow, with 5–6 strong bristles. Labrum pale brown and somewhat straight sided. Labellae expanded and densely spinose below.

THORAX: Brown and darker on top. Scutellum with a posterior pair of bristles and an anterior pair of hairs, which are shorter and finer than hairs at rear of scutum. Three well developed notopleural bristles. Mesopleuron bare.

ABDOMEN: Tergites 1–6 dark brown with shortish hairs, but a little longer and more conspicuous at posterior margin of 6. Venter greyish with short hairs on segments 3–6. Hypopygium brown with dirty yellow anal tube and as in Fig. 1.

LEGS: Hind and middle legs largely brown, front pair brownish yellow. Front tarsi with hair palisades on segments 1–4. Mid tibia with hair palisade extending ½–⅔ of length. Apical spur >¾ length of metatarsus. Hairs beneath basal half of hind femur about 3 × length of hairs on anterior face. 10–14 postero-dorsals on hind tibia, with only those on middle third a little robust.

WINGS: Mean length 1.63 mm (range 1.53–1.73 mm). Costal index 0.43–0.46. Costal ratios 3.09–4.39:1.18–1.67:1. Costal cilia 0.10–0.13. Wing membrane yellowish grey. Veins pale brownish. Sc fades out just before R1. A minute hair at base of vein 3. Axillary ridge with two bristles which are stronger than costal cilia. Haltere with yellow knob and darker stem.

FEMALE: Similar to male. Proboscis with broader labrum with convex lateral margins. Labellae almost devoid of spines below. Hairs on segments 3–6 of abdominal venter. Tergites 5–8 as in Fig. 3. Costal Index 0.46. Costal ratios 3.44:1.64:1. Costal cilia 0.12 mm.

AFFINITIES: In the keys of Lundbeck (1922) *M. clemonsi* will run to couplets 52 in Group VI or 39 in Group VII, depending on whether the costal index is above or below 0.44. Several species described since 1922 also key to these points, with the result that considerable confusion now exists. The species which need to be distinguished from *M. clemonsi* are *M. abdita* Schmitz, *M.*

1

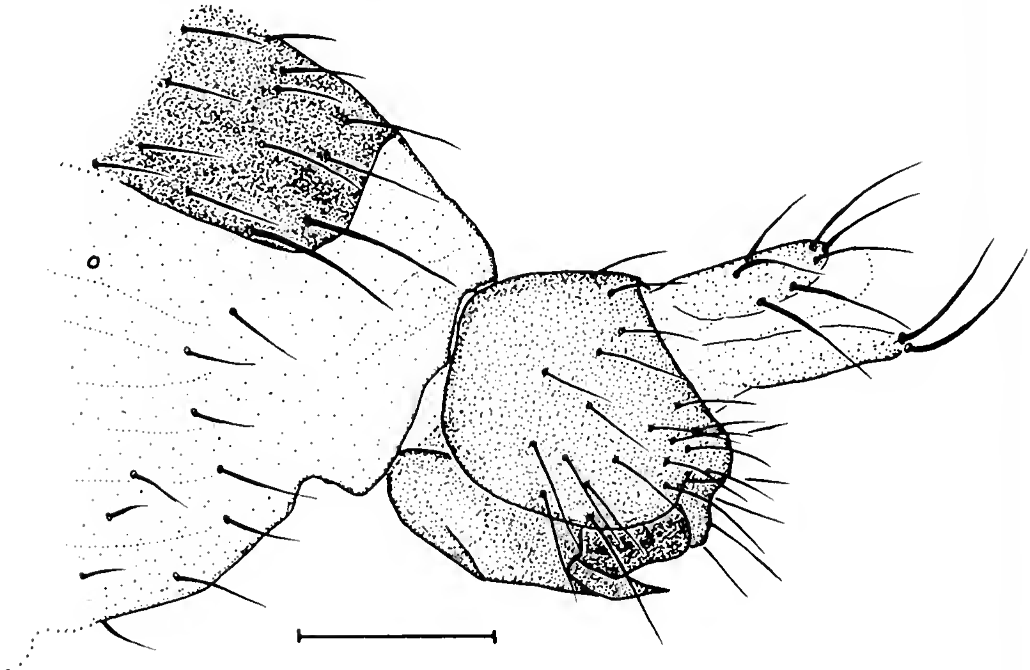


FIGURE 1
Megaselia clemonsi n. sp. hypopygium of male viewed from left side (scale line = 0.1 mm).

2

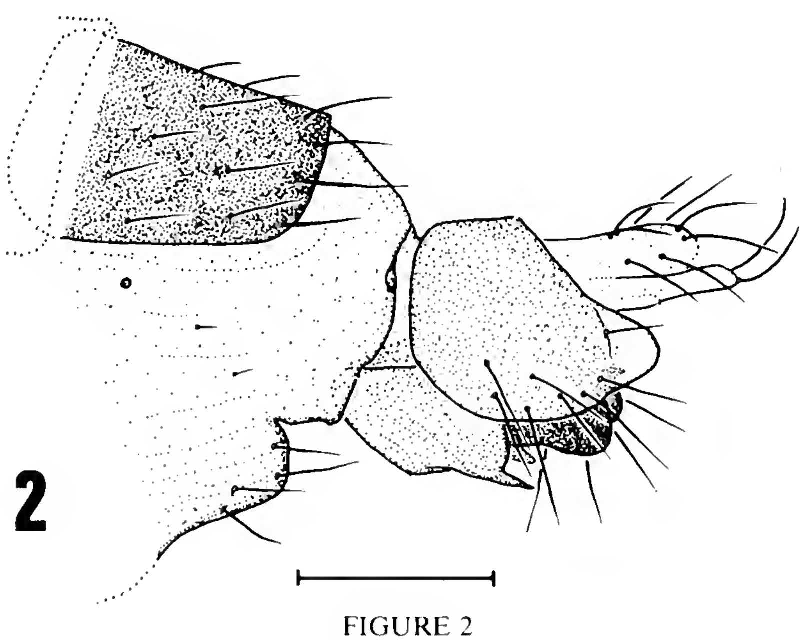
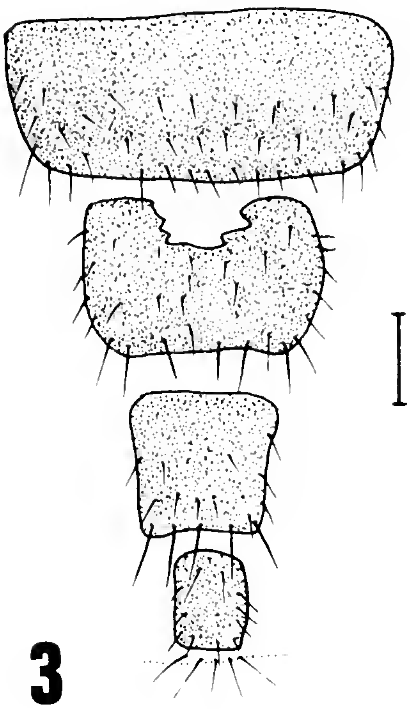


FIGURE 2
Megaselia hilaris hypopygium of male viewed from left side (scale line = 0.1 mm).

bifida Disney, *M. bovista* (Gimmerthal) (= *M. exigua* Wood), *M. hilaris* Schmitz, *M. latior* Schmitz, *M. pullipalpis* Colyer, and *M. sylvatica* (Wood).

M. bifida is immediately distinguished, in both sexes, from the rest of the complex by the presence of bifid spines in the distal comb of the posterior face of the hind tibia (Fig. 8 in Disney, 1983b). *M. pullipalpis* has the costal index clearly shorter than 0.4 and the male's anal tube is distinctly shorter than in *M. clemonsi. M. latior* and *M. sylvatica* have been confused with each other in the past (see below) but are readily distinguished, in both sexes, from the rest of the complex by having the middle notopleural bristle virtually reduced to a hair. In effect these two species only have 2 notopleural bristles each side. All the other species have 3.

M. abdita was described on the basis of a series of females only, from Afghanistan (Schmitz, 1959). However, Dr M. Báez has sent me a series of males and a female from Tenerife. The female agreed with Schmitz's description except in one particular. Schmitz wrote of the



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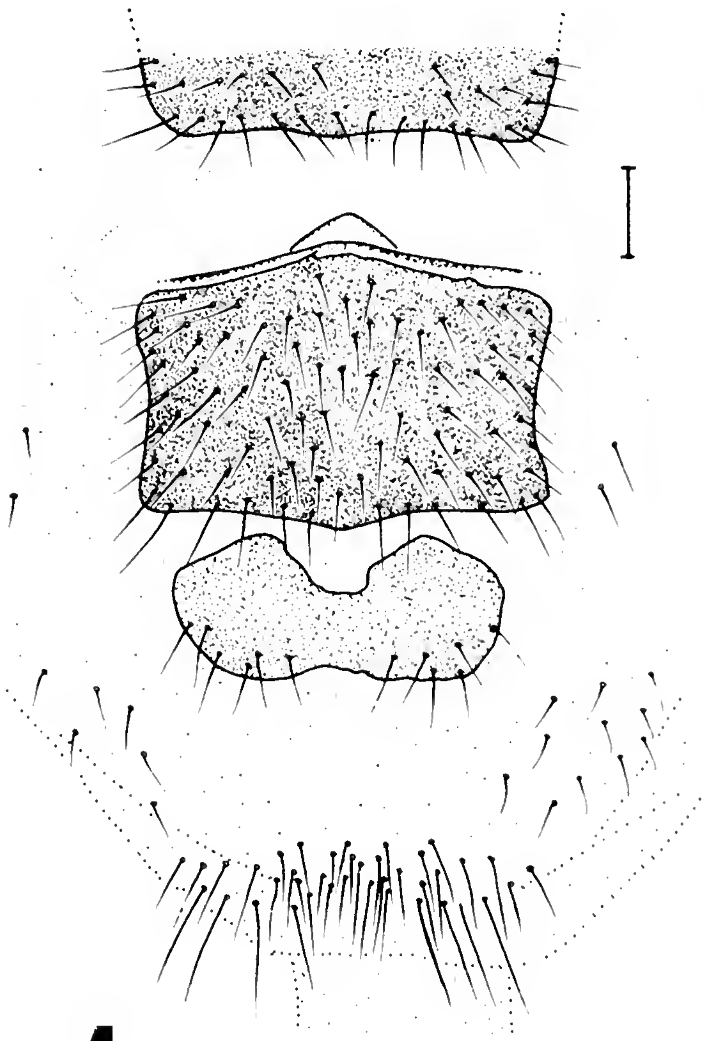

4

FIGURE 3
Megaselia clemonsi n. sp. female abdominal tergites 5–8 (scale line = 0.1 mm).

FIGURE 4
Megaselia sylvatica female abdominal tergites 5 and 6, and posterior part of 4 (scale line = 0.1 mm).

abdominal venter 'der ganz unbehaarte Bauch'. Dr Báez's specimen has a median band of short hairs in a dense field on segments 3–6. Through the co-operation of Dr H. Ulrich I have examined two paratypes of *M. abdita* and in both the same field of hairs is present. However these hairs can be readily overlooked if the specimens arc not viewed from the correct angle. It is clear that Dr Báez's female is indistinguishable from *M. abdita*, so that the males from Tenerife represent the undescribed male of this species. The male of *M. abdita* and *M. bovista* can be distinguished from *M. clemonsi* and *M. hilaris* by their simple labellae bearing few spines below.

M. hilaris, like *M. clemonsi*, has densely-spinose labellae. The two species can be separated by comparing the hypopygia (Figs. 1 and 2), and in particular by the lack of hairs on the dorsal half of the epandrium in *M. hilaris*.

The females of *M. abdita* are immediately distinguished from those of *M. bovista* and *M. clemonsi* by the closely crowded hairs, in several rows on each segment, on segments 3–6 of the venter. *M. bovista* is distinguished from *M. clemonsi* by having all the legs dark and by more hairs (90–110) on the frons. I have seen no authenticated female of *M. hilaris* (ie, a female obtained *in cop.*, in a reared series, or strongly associated in terms of the circumstances of collection).

Megaselia differens Schmitz, 1948b

In reporting an undetermined species of *Megaselia* from Tow Hill Nature Reserve, North Yorkshire (Grid ref. 34/8286) as '*Megaselia* sp 2' (Disney, 1979) it was noted that 'it somewhat resembles *M. differens*'; a species only known from Austria. Through the co-operation of Dr Ulrich I have examined a specimen of *M. differens* from the Schmitz collection. It is indistinguishable from the Tow Hill specimen. I have a second British specimen collected by Dr A. G. Irwin at the Bridge of Brown (Grid ref. 38/1121), 15 June 1982. The Tow Hill specimen was collected 18 June 1976. These represent the first British records of this species, which is keyed and described by Schmitz and Beyer (1965, 1974).

Megaselia drakei n. sp. (Fig. 5)

Type locality

England: Ferry House, Lake Windermere, Cumbria

Type material

Holotype: ♂, Ferry House, Lake Windermere, Cumbria (Grid ref. 34/3995) 31 October/6 November 1981, leg. C. M. Drake. Paratypes: 2 ♂, Tarn House lawn, Malham Tarn, North Yorkshire (Grid ref. 34/894672) 20/22 September 1980 and 25/26 September 1980, R. H. L. Disney; 1 ♂, Flatford Mill, Suffolk (Grid ref. 62/079330) 15/17 August 1981, R. H. L. Disney.

Etymology

The species is named after C. M. Drake, who collected the holotype specimen.

Description

Only male known: HEAD: Frons brown with 50–70 hairs. Antero-lateral, antial and upper supra-antennal bristles forming a regularly curved row, with the antials slightly nearer the antero-laterals. Lower SA's as strongly developed as uppers, which are about as far apart as pre-ocellars. Antenna and arista dark. Palps dirty yellow with a field of shallow pits bearing more erect hairs on the external face, with 5–6 bristles, of variable length, distally and a long bristle on inner face. Labrum brownish with convex sides and tip of epipharynx darkened. Labellae a little enlarged but with only a few scattered spines below.

THORAX: Dark. Scutellum with a posterior pair of bristles and an anterior pair of hairs, which are as fine as (or finer than) hairs at rear of scutum. Three well developed notopleural bristles. Mesopleuron with 1–6 hairs (usually 3 or more).

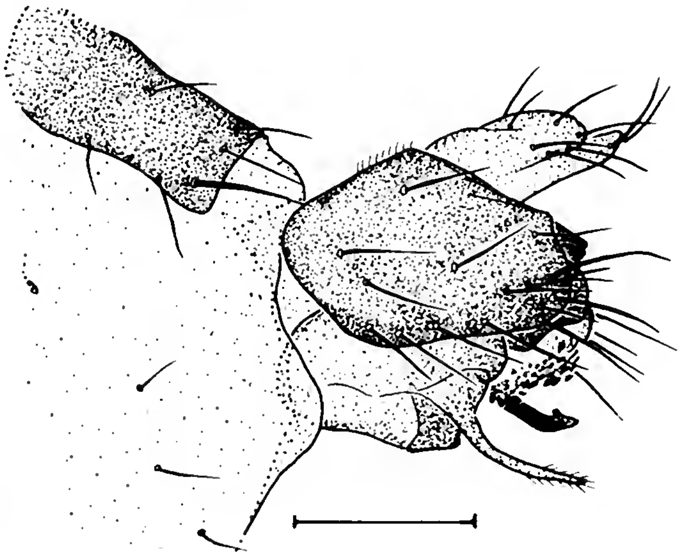
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FIGURE 5
Megaselia drakei n. sp. hypopygium of male viewed from left side (scale line = 0.1 mm).

ABDOMEN: Tergites dark brown with shortish hairs mainly in distal halves. Venter greyish with a few hairs on segments 3–6. Hypopygium as Fig. 5, with epandrium and hypandrium brown to dark brown and anal tube dusky. The process of the left side of the hypandrium is an almost parallel-sided, rod-like structure.

LEGS: All legs dark brown to blackish. Front tarsi with hair palisades on segments 1–4. Mid-tibia with hair palisade extending <½ length. Apical spur nearly ⅔ length of metatarsus. Hairs beneath basal half of hind femur at most only a little longer than hairs of anterior face and clearly shorter and weaker than antero-ventral row in distal half. Hind tibia with 13–18 postero-dorsals, which are about as strong as hairs of distal comb of posterior face.

WINGS: Mean length 1.31 mm (range 1.12–1.50 mm). Costal index 0.36–0.39. Costal ratios 3.34–4.49:1–1.35:1. Costal cilia 0.09–0.12 mm. Wing membrane almost clear. Thick veins brownish, but thin veins very pale. Sc ends well before Rl. No hair at base of vein 3. Axillary ridge with two unequal bristles, the distal one being at least as robust as costal cilia. Haltere uniformly dark brown.

AFFINITIES: In the keys of Schmitz and Delage (1974) *M. drakei* runs to couplets 7 or 38 of Abteilung V, depending on whether the costal cilia are <0.1 mm or >0.1 mm. The distinctive hypopygium will immediately distinguish it from other species running to these couplets.

Megaselia eisfelderae Schmitz, 1948a (Fig. 6)
This species can easily be confused with *M. lutea* (Meigen). Males are readily separated by examination of the mid-tarsi. In males of *M. lutea* the last segment is about 2 × length of segment 4, and usually somewhat inflated (Fig. 7). In *M. eisfelderae* the last segment is normal (Fig. 6). I have a series of males and a female, collected along with the common *M. lutea*, in mature fen carr at Malham Tarn, North Yorkshire (Grid ref. 34/888672) in August 1983. These specimens represent the first British records. *M. eisfelderae* has previously been recorded from Austria, Germany, Holland, Finland, and the Nearctic Region.

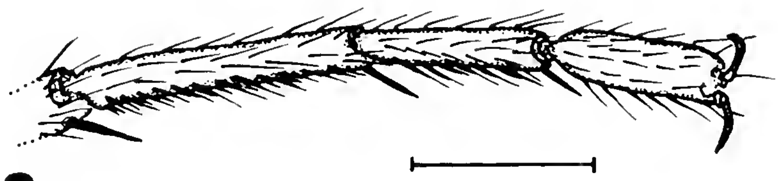

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FIGURE 6
Megaselia eisfelderae tarsal segments 3–5 of middle leg in male (scale line = 0.1 mm).

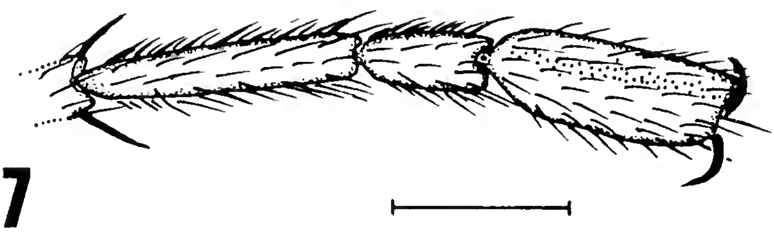

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FIGURE 7
Megaselia lutea tarsal segments 3–5 of middle leg in male (scale line = 0.1 mm).

Megaselia latior Schmitz, 1936 (Fig. 8)

sylvatica auett. nec (Wood, 1910) **Desig. nov.**
Through the co-operation of Dr H. Ulrich and B. H. Cogan I have remounted cotypes of *M. latior* and *M. sylvatica*. This revealed that the species that has been attributed to *M. sylvatica* in Britain by all workers since Wood is in fact *M. latior*. *M. sylvatica* has proved to be a common species which has long been known under a synonym. The details and distinction between the species are given below (under *M. sylvatica*).

Apart from recording *M. latior* in August 1983 at Malham Tarn, North Yorkshire (Grid ref 34/895672) I have specimens from Berkshire, Cambridgeshire, Essex, Rotherham, Suffolk, and Norfolk, the latter having been attributed to '*M. sylvatica*' by Disney and Evans (1979). Wood's female specimen, erroneously attributed by *M. sylvatica* (see below), came from Tarrington Hereford.

M. latior represents an addition to the British List. It has previously been recorded from Belgium.

Megaselia melanostola Schmitz, 1942
This species will run to couplets 5, 11 or 13 in Group VI of Lundbeck's (1922) keys. The elongated anal tube (Abb. 1c in Schmitz, 1942) will distinguish it from the other species running to these couplets. A male from Rowantree Scar (Grid ref. 44/032932) 20 June 1978 and another from Tranmire (Grid ref. 45/765118) 14 September 1978 were both included in the category '*Megaselia* spp' by Disney *et al* (1981). I have also 3 males and a female collected by J. M. Nelson at Flanders Moss, Perthshire (Grid ref. 26/623976) June 1981 and 27 May/2 June 1982. This species is an addition to the British List, having been reported previously from Austria, Germany and Sweden.

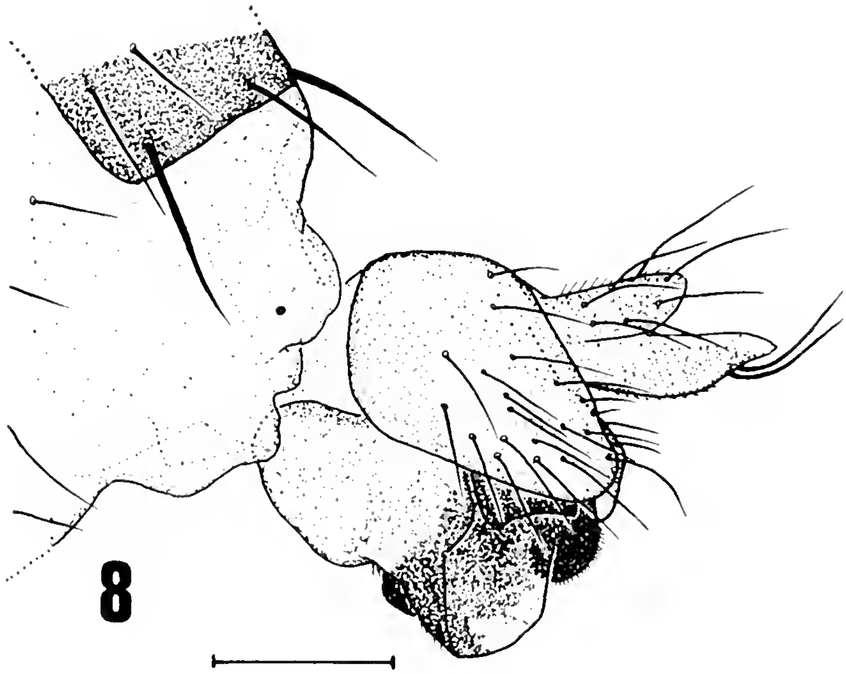

FIGURE 8
Megaselia latior hypopygium of male viewed from left side (scale line = 0.1 mm).

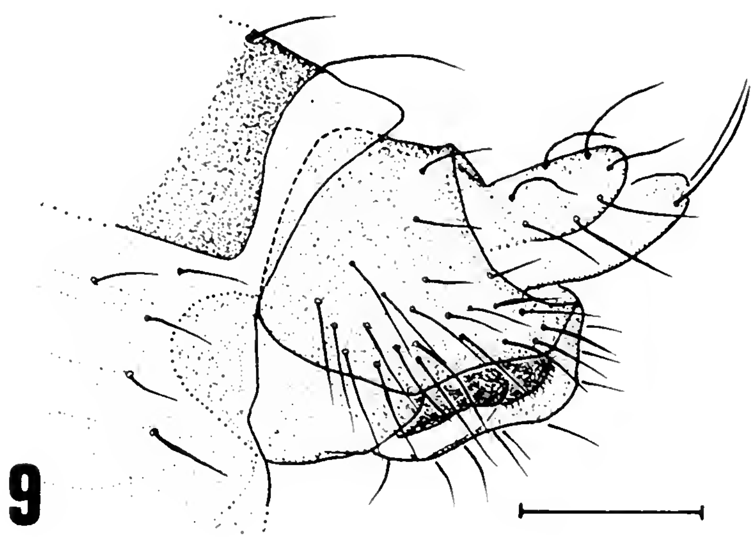

FIGURE 9
Megaselia sylvatica hypopygium of male viewed from left side (scale line = 0.1 mm).

Megaselia sylvatica (Wood, 1910) (Figs. 4 and 9)

impolluta (Schmitz, 1920) **Syn. nov.**
Schmitz (1939), subsequent to his original description of *M. impolluta*, pointed out that the female was very distinctive in that the sixth abdominal tergite was abbreviated, and a patch of long hairs was developed behind the tergite (Fig. 4).

According to a label attached to Wood's type series of *M. sylvatica* the specimens were examined by Schmitz in 1926. I have also examined the same type series and have, through the co-operation of B. H. Cogan, remounted the single female and a male. I have designated the latter the lectotype. This lectotype is the same species as males of '*M. impolluta*' obtained in reared series (Disney and Evans, 1979, 1982), whose females are as in Fig. 4. It is clear, therefore, that *M. impolluta* is a synonym of *M. sylvatica*. The female in Wood's series is not *M. sylvatica*. It is *M. latior*. It would seem that Schmitz failed to appreciate this incorrect association and thus concluded that he had been right to establish *M. impolluta* as distinct from *M. sylvatica*. I have *M. latior* females obtained in reared series, and erroneously attributed to *M. sylvatica* (see above), through following Schmitz. The two species are readily separated in the female sex by the form of abdominal tergite 6. In *M. sylvatica* it is as in Fig. 4. In *M. latior* it is subequal to, or longer than, tergite 5. The males are distinguished by the hypopygia, in particular *M. latior* has the anterior part of the penis complex developed into an elaborate expanded structure that protrudes even when the penis is withdrawn (cf. Figs. 8 and 9). *M. sylvatica* is widely distributed in Britain.

Acknowledgements

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THE VASCULAR FLORA OF DISUSED CHALK PITS AND QUARRIES IN THE YORKSHIRE WOLDS

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Introduction

The Yorkshire Wolds form the northernmost section of the English chalk of Upper Cretaceous age, extending from the River Humber in an arc to the sea at Flamborough Head, covering an area of approximately 775 km^2.

The Wolds have been extensively quarried for chalk and many workings have been abandoned, only thirteen working quarries remaining in 1983. The abandoned quarries and pits range in size from 0.05 to 10 ha. The small chalk pits were excavated primarily as a local source of building stone and aggregate whereas the larger pits and quarries were chiefly producing chalk for agricultural lime used locally (Hull and Thomas, 1974, Allison, 1976). Current working quarries produce chalk for use in paint whiting and cement manufacture. Many of the smallest disused pits have been infilled or ploughed out and some larger quarries are used as landfill sites.

It is well known that some disused chalk and limestone quarries in the British Isles are important botanical sites (Davis, 1979) and the importance of such sites in the Wolds has been recognized by the Yorkshire Naturalists' Trust, with four quarries and pits being protected as Nature reserves or management agreement sites; two of these (Wharram Quarry and Kiplingcotes chalk pit) are also Sites of Special Scientific Interest. Ratcliffe (1982) also emphasizes the botanical interest of disused Wolds quarries along the Wolds Way long distance footpath. This paper aims to show that other disused pits and quarries in the Yorkshire Wolds are of botanical conservation interest.

Sample sites and methods

A total of 227 quarries originally located from aerial photographs and 1:10000 Ordnance Survey Maps were visited between November 1981 and February 1982; thirty of these were subsequently selected for botanical survey. During June and July 1982, a total list of vascular plants was compiled for each of these sites as part of a more detailed ecological survey, the results of which are reported elsewhere (Jefferson, in press). Additional plant records were added, where necessary, from observations made in May and June 1983. Table 1 gives details of the sites surveyed.

Results and discussion

The survey recorded 256 species of vascular plant. Table 2 lists some of the more interesting species recorded and the number of sites at which they occurred. This list includes species restricted both locally and nationally, some typical calcicoles and naturalized and introduced species. A number of species of the genus *Hieracium* (excluding *H. pilosella*) were recorded from seven sites; unfortunately identification to species level was not possible.

Jefferson (in press) showed that a range of plant community types occurred in Wolds quarries including early successional communities with discontinuous vegetation cover on quarry floors, spoil heaps and chalk scree through to later successional tall grassland communities with some scrub invasion, occurring on quarry floors and side slopes with deeper soil. Clearly there is an age component influencing the plant communities and the overall species composition. On a smaller scale, Usher (1979) demonstrated the effects of age on plant community structure by looking at parts of the quarry floor at Wharram which had been successively abandoned over a thirty-year period. Botanical diversity decreased through the succession from the open dicotyledon stage to the grassland stage. Additionally, Jefferson (in press) showed that site area and distance of a quarry from semi-natural chalk grassland can have an important influence on species composition and species richness. Other factors such as substrate characteristics and extent of grazing can also be important in quarries generally (Humphries, 1980).

The quarry flora includes pioneer colonists of bare chalk (for example, *Desmazeria rigida*, *Hieracium pilosella*), many species typical of chalk grassland (for example, *Carlina vulgaris*,

TABLE 1
Site Details

Chalk Quarry/Pit	Grid reference	Cartographic Area (ha)	Total number of species
Rifle Butts	SE 898427	0.25	91
Etton	SE 970434	1.12	89
Millington	SE 831535	0.09	55
Bishop Wilton	SE 805559	1.15	73
Staveley (A)	SE 913501	0.05	41
Staveley (B)	SE 918501	0.06	39
Pilmoor	TA 091788	0.53	68
Whitegate	SE 958756	0.63	86
Poor Wood	SE 829509	0.22	58
Thirkleby	SE 915698	0.38	68
Burrow House	SE 983668	0.29	54
Wharram	SE 859653	6.22	111
Eppleworth	TA 021324	1.30	93
Nunburnholme	SE 857478	0.25	64
Burdale	SE 872626	2.83	108
Middleton	SE 955499	0.29	40
Kiplingcotes	SE 915435	1.80	90
North Grimston	SE 857670	0.21	84
Aldro	SE 813626	0.28	68
Helperthorpe	SE 960705	0.42	57
Low Mowthorpe	SE 885659	0.25	67
Flixton	TA 039793	0.96	93
North Dalton	SE 942503	0.40	80
Linghall	SE 917727	0.08	62
Muston	TA 087798	0.09	55
Humberfield	TA 012264	3.20	81
Pefham	SE 858578	0.10	22
Staxton	TA 011783	0.66	91
High Mowthorpe	SE 891699	0.08	45
Sledmere	SE 921634	0.33	76

Thymus praecox), arable and pasture weed species (for example, *Stellaria media*, *Cirsium arvense*, *Senecio jacobea*) and naturalized plants such as *Centranthus ruber* and *Buddleja davidii*. Robinson (1902) mentions the presence of a number of naturalized and casual species occurring in quarries at Hessle and Willerby on Humberside including *Diplotaxis muralis* and *Antirrhinum majus*. The species list (Table 2) contains no national rarities but a number of species such as *Astragalus danicus* and *Cirsium eriophorum* are restricted nationally (Perring and Walters, 1976) and *C. acaule*, *Ophrys apifera* and *Blackstonia perfoliata* are rare in the North of England being near the northern limit of their range in Britain. Crackles (1974) states that the latter two species show a preference for open habitats in the North of England where competition pressure is less. This is partly confirmed by Julian (1983) who showed that at Wharram, *O. apifera* is restricted to the open quarry floor where the soil is approximately 5 cm deep and of low nutrient status. As soon as the soil has developed sufficiently to support a closed community of tall grasses (*Arrhenatherum elatius*, *Dactylis glomerata*) and herbs (*Centaurea nigra*, *Lathyrus pratensis*) *O. apifera* is outcompeted and excluded.

The Wolds is predominantly an area of intensive arable farming where extensive areas of semi-natural chalk and neutral grassland are now restricted to the dry valley systems. In the last twenty years an estimated 43 per cent of this grassland has been changed to arable, improved

TABLE 2

A partial list of vascular plant species recorded from chalk pits and quarries in the Yorkshire Wolds during 1982/83.

Acinos arvensis	1	‡*Erucastrum gallicum*	1
**Amsinkia intermedia*	1	*Euphorbia exigua*	1
Anacamptis pyramidalis	8	*Festuca gigantea*	1
Anthyllis vulneraria	6	*Filipendula vulgaris*	1
Astragalus danicus	1	*Galium album*	2
Arabis hirsuta	6	*Gentianella amarella*	7
Avenula pratensis	4	†*Geranium sanguineum*	1
Blackstonia perfoliata	1	*Gymnadenia conopsea*	1
Brachypodium pinnatum	9	*Helianthemum nummularium*	6
B. sylvaticum	1	*Hypericum hirsutum*	3
Bromus erectus	8	*Koeleria macrantha*	7
B. ramosus	1	†*Lathyrus tuberosus*	1
**Buddleja davidii*	1	†*Linaria repens*	1
Campanula glomerata	10	*Listera ovata*	2
†*C. latifolia*	1	*Malva moschata*	1
Carex sylvatica	1	**Melilotus officinalis*	2
Carlina vulgaris	5	*Mycelis muralis*	4
Centaurium erythraea	3	*Onobrychis viciifolia*	1
**Centranthus ruber*	1	*Ophioglossum vulgatum*	1
Cerastium arvense	2	*Ophrys apifera*	2
Chaenorhinum minus	2	*Origanum vulgare*	7
Cirsium acaule	1	*Picris hieracioides*	4
C. eriophorum	4	*Polygala vulgaris*	5
Cornus sanguinea	1	*Prunus avium*	1
†*Coronilla varia*	1	*Reseda lutea*	5
Coronopus squamatus	1	*Sagina nodosa*	1
Dactylorhiza fuchsii	9	*Sanguisorba minor*	15
Daucus carota	4	*Scabiosa columbaria*	8
Desmazeria rigida	7	*Sedum acre*	1
**Diplotaxis muralis*	1	*Senecio erucifolius*	1
Echium vulgare	1	*S. viscosus*	1
Erigeron acer	1	*Stachys arvensis*	1
Eriophila verna	1	*Thymus praecox*	10

* Naturalized species
† Introduced species
‡ Casual species

pasture and forestry, and in some cases cessation of sheep grazing has resulted in extensive scrub development (Rafe and Jefferson, 1983). Disused quarries therefore provide refuges for chalk grassland species declining due to habitat change as well as for early successional species characteristic of open ground on calcareous soil.

It is therefore important that some of the botanically interesting disused quarries and pits on the Wolds are retained for conservation and research. Many sites will, however, require some form of management to prevent the succession proceeding to a less diverse community dominated by tall grasses such as *A. elatius*. Management has already been implemented at Wharram and the rationale of this is discussed in the reserve management plan (Anon, 1973).

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BOOK REVIEW

Distribution Atlas of Woodlice in Ireland by **Declan Doogue** and **Paul T. Harding**. An Foras Forbartha, St Martin's House, Waterloo Road, Dublin 4, Ireland. 1982. £2.50, including postage.

The main part of this work is a series of maps, one for each of the species recorded in Ireland, with text on a facing page. There is a Preface and an Introduction, followed by a Check List of the Irish species with a further list of species absent from Ireland but occurring in Britain. A section on the history of recording and the growth of the Irish species list through time gives a valuable insight into the origins of the present work. This is followed by sections on the operation of the Woodlouse Recording Scheme, the storage of records, identification and factors affecting distribution. The text accompanying the maps gives a very brief description of identifying features, habitat preferences, and overall distribution. Each account ends with the number of vice-counties from which the species has been recorded and a key to those references in the Bibliography mentioning the species.

All in all this is far more than a simple atlas. It contains a wealth of information about the Irish Woodlice (and indirectly about the British ones too) and with 146 references, leaves no stone unturned in the exposure of their past investigation.

The remarkable thing is that this has been achieved by a tiny band of dedicated people who between them have covered just about every 10 km square in Ireland. They deserve our congratulations and thanks. The Atlas is a worthy monument to their achievement.

SLS

THE SOLITARY BEES AND WASPS (*HYMENOPTERA: ACULEATA*) OF A SAND-PIT AT SWINCARR PLANTATION, NEAR YORK

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The sand-pit (SE 6856) was found on 21 August 1967 and its solitary bees and wasps were studied from April to July 1968 and from March to September 1969. Access to the site was then prevented and the pit has now been filled. The sand-pit (Fig. 1), which was about 22 metres × 22 metres, had standing water at its centre surrounded by an area of damp sand and then of dry sand. The extent of the water and damp sand varied during the year. No vegetation was present in the pit, while the path and an area immediately to the left of the pit was largely bare of vegetation.

There were thirty-five species of solitary bees and wasps recorded, some of which were found nesting in very large numbers. The three most numerous species were *Andrena clarkella* (Kirby) which in 1968 was represented by over 900 freshly-dug burrows, *Mellinus arvensis* (Linn.) in 1969 by about 140 burrows and *A. barbilabris* (Kirby) where a burrow count was not possible but probably approached that of *A. clarkella*.

Males of *A. clarkella* emerged in early April closely followed by the females. After a period of mating the males disappeared by the middle of April or a little later. The females dug the burrows and provisioned the cells but had disappeared by the middle of May. There was one generation each year. On emerging, the males walked and flew over these sunlit banks and flat areas waiting for the females to emerge. Males approached and pounced on any small dark object, including inaminate objects and other males, but left immediately after making contact if the object was not a female. The male grasped the female with fore and middle pairs of legs around the waist and rear thorax and extruded his genitalia towards the female opening. Females usually struggled so the two bees separated and no successful copulations were seen. Males were seen to chase females in flight even if carrying pollen. The females dug their burrows in the flat area mainly to the left of the sand-pit (Fig. 1). The nesting area had a stable sand surface and was moss-covered but with intervening bare patches. In 1969 the left area contained 354 freshly-dug burrows but in 1968 a sample area of 33.5 square metres contained 308 burrows; the estimate for the left area would be therefore about 900 burrows. The female dug the burrow with her forelegs, excavated sand being pushed backwards by the middle and hind legs. As the burrow became deeper, the sand was first brought to the surface and then moved horizontally away from the entrance so that a mound of about 7 cm diameter was produced. On flat ground, the entrance of the burrow was in the centre of the circular mound, while on sloping ground the mound became oval in shape, with the entrance at the upper edge. The presence of the mound enabled one to separate freshly-dug burrows from emergence holes. At first the entrance might be closed or open, but as soon as the female started to collect pollen the entrance was kept closed. Thus, on arriving with a pollen load on the hind legs the female dug through the entrance plug with her forelegs, sometimes assisted by the middle legs. As the female disappeared into the burrow, the sand collapsed behind her, filling the entrance. Similarly, on leaving, the sand collapsed behind the female, but she also moved sand from the edges of the mound to the entrance with her hind legs, which were held at right-angles to her body. First departures from the freshly-dug burrows were accompanied by walking around the mound followed by flying around the nesting area in order to learn the locality of the burrow. The female then proceeded to stock her cells with pollen and nectar. Some burrows were excavated to determine their structure: the main burrow on the flat area went straight down for about 11.5 cm, having a diameter of about 1 cm, with an entrance plug about 0.6 cm in depth. About six cells were present per burrow, either directly attached to the main burrow or with a short side-burrow. The cells were separate from each other, with external dimensions of about 1.6 cm length and 0.8 cm diameter. The inside walls of each cell were smooth and shiny, except for the plug of soil with which it had been sealed. The larvae, which usually laid in a curved position on the pollen-nectar ball, were capable of very little movement, mainly an up-and-down movement of the head.

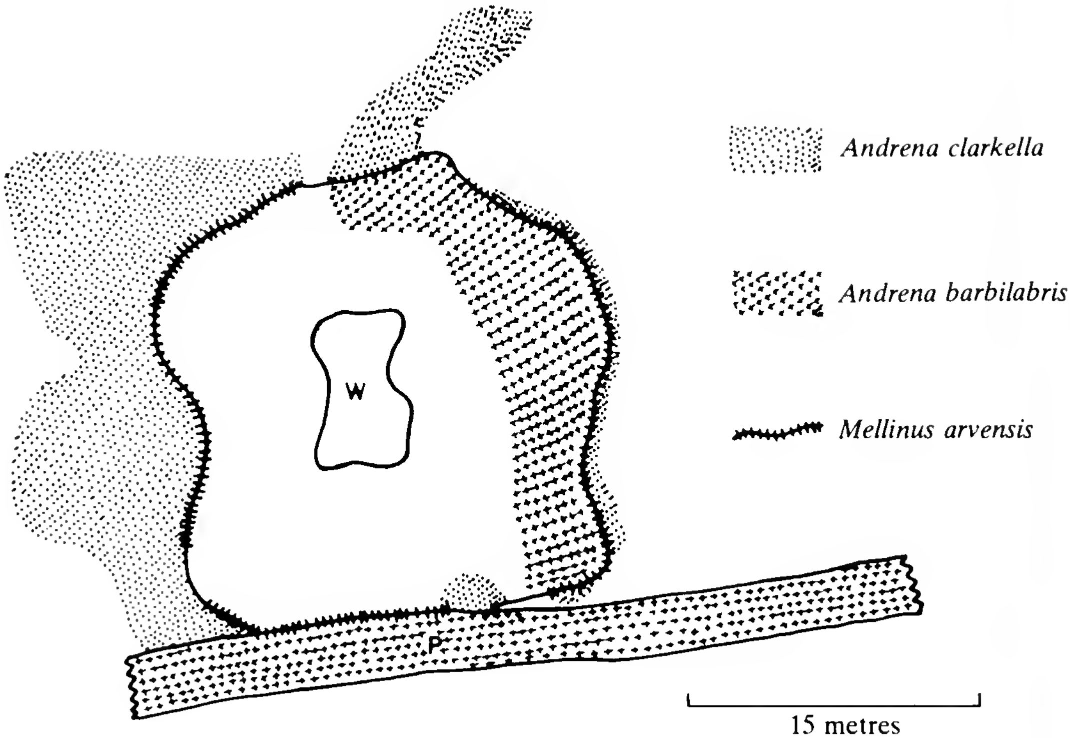

FIGURE 1
Sketch map of sand-pit and path with nesting areas of *Andrena clarkella*, *A. barbilabris* and *Mellinus arvensis*. (P = Path, W = Standing water, ——— = boundaries of sand-pit and path.)

Fully-grown larvae were found in early May and early June. Nixon (1954) reported the larvae pupate and emerge as adults in the autumn, with the adults over-wintering in the cells.

The cleptoparasite of *A. clarkella* is *Nomada leucophthalma* (Kirby), which appeared in the spring with its host but disappeared after its host at the end of May. During the phase when the burrows were open female cleptoparasites were seen to enter the burrows. The female *Nomada* would follow a female *Andrena* in flight and moved onto the surface of the mound after the female *Andrena* had dug in. Soon after the middle of April the female *Nomada* were seen to dig into the burrow mainly with her forelegs but with the middle legs assisting. Bernard (1951) reported that underground the female *Nomada* laid an egg in the cell of its host. On hatching the *Nomada* larva would kill the egg or young larva of its host before eating the pollen-nectar ball.

The adults of *A. barbilabris* emerged soon after the middle of May, the males a few days before the females. The males had disappeared by the middle of June and the females by early July. The nesting areas were the bare dry mobile sand areas of the path and the right side of the sand-pit (Fig. 1). At first males were numerous, 20–30 males being seen together either flying near, walking over or stationary on the sand surface, often at the entrances of the emergence holes. The males entered burrows looking for the females and followed the females in flight. The mating posture was similar to that of *A. clarkella* and again, although many attempted copulations were seen, a successful copulation was not observed. The female would raise her legs dorsally above her body and the pair would separate. Several males were also seen clustered around a female. The female dug a burrow, creating a mound of about 2.5 cm diameter and about 0.6 cm at its highest point. During the provisioning phase the burrows were kept closed.

The cleptoparasite of *A. barbilabris* is *Specodes pellucidus* (Smith, F.). Only females of *Sphecodes* emerged a few days before that of their hosts. The female *Sphecodes* spent much time walking over the sand surface tapping the sand with her antennae, paying particular attention to the mounds. From the middle of June the female *Sphecodes* started to dig into the mound with

her forelegs, the middle and hind legs pushing the excavated sand to the side. The female cleptoparasites had disappeared by early July but unlike *Nomada* both sexes emerged in mid-August to mate. Afterwards the males died and the females over-wintered underground.

The adults of *Mellinus arvensis* emerged in late July to early August, the males up to a week before the females. Males disappeared towards the end of August while some females were still active towards the end of September. *M. arvensis* is a fly-hunter, mainly stocking its cells with Muscidae (Hamm & Richards, 1930). The nesting area was associated with the banks of the sand-pit (Fig. 1). A count of freshly-dug burrows in 1969 produced an estimate of 144 burrows.

Fig. 1 shows that the high-density nesting areas of the above three species do not overlap so that interference between burrow systems was unlikely. Each species was associated with a nesting area of different characteristics, each habitat being presumably selected by the nesting female. The times of appearances of the three species also showed no overlap.

Three other species were found nesting. A few burrows of *Halictus rubicundus* (Christ) were found in the *A. clarkella* area. Six females were found from early May to the middle of June, one seen entering an open burrow with a pollen load. The cleptoparasite of *H. rubicundus* is *Sphecodes gibbus* (Linn.) and it was seen from late July to early August. A few burrows of the second species, *Colletes succinctus* (Linn.), were found in the vertical bank faces during August. The burrows were left open and its cleptoparasite *Epeolus cruciger* (Panzer) was seen to follow female *Colletes* and enter burrows when females were absent. Three small patches of burrows of the third species *Psen equestris* (Fabricius) were found on sloping ground in the *A. clarkella* area. In 1969 counts of freshly-dug burrows in the three patches gave 46 burrows (10+27+9). *P. equestris* was active during July. The small number of individuals and/or small area of nesting site required by these three species was unlikely to have produced much burrow interference with the three main species.

The other species recorded are as follows. Females of the wingless scolioid wasp, *Myrmosa atra* (Panzer), were found from July to early September. Little is known of the habits of this cleptoparasite but its hosts are probably ground-nesting sphecoid wasps. Two species of pompiloid wasps, the spider-hunting *Priocnemis parvula* Dahlbom and the cleptoparasite *Evagetes crassicornis* (Shuckard) and one solitary vespoid wasp, *Ancistrocerus scoticus* (Curtis) were also found. The additional sphecoid wasps were the acridid nymph-hunter *Tachyspex pompiliformis* (Panzer), the fly-hunters *Crabro cribrarius* (Linn.), *C. peltarius* (Schreber), *Crossocerus quadrimaculatus* (Fabricius), *Oxybelus uniglumis* (Linn.), and the aphid-hunter *Diodontus tristis* (Vander Linden). The *Andrena* mining bees included *A. denticulata* (Kirby) and *A. fuscipes* (Kirby) with their cleptoparasite *Nomada rufipes* Fabricius. *A. haemorrhoa* (Fabricius), *A. tarsata* Nylander, *A. wilkella* (Kirby) with its cleptoparasite *N. striata* Fabricius. The cleptoparasite *N. marshamella* (Kirby) was also found but its very common host *A. jacobi* Perkins, R. C. L. was not recorded. Among the halictine bees were *Lasioglossum calceatum* (Scopoli), *L. fratellum* (Pérez), *L. punctatissimum* (Schrenck), and *L. rufitarse* (Zetterstedt). The cleptoparasite *Sphecodes fasciatus* von Hagens was found in both the female and male sex so its identity is certain. The megachilid bee, *Megachile willughbiella* (Kirby) was also taken but since this bee is an aerial nester (usually in decayed trees), it must have been just passing over the sand-pit.

With the exception of *L. fratellum* and *L. rufitarse* all the above species are widely distributed throughout England, although many such as *M. atra*, *T. pompiliformis*, *C. succinctus*, and *A. tarsata* are local in distribution, being restricted to sandy places. *L. fratellum* is probably widespread in the north and west of England and *L. rufitarse* in the north and west midlands areas.

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BOOK REVIEWS

Resource Competition and Community Structure by **David Tilman**. Pp. xi + 296, including many diagrams. Princeton University Press, 1982. £19.40 hardback, £7.05 paperback.

Since their first monograph in population biology Princeton has regularly produced excellent innovative texts presenting to ecologists new ideas and new hypotheses to test, and Number 17 by David Tilman is no exception. Against a background of resource utilization and partitioning, he explains, via consumption constraint curves, why there is such a diversity of plants and animals. The ideas are carefully developed in a well written, easily understood text which proceeds through the use of graphical rather than mathematical argument and which examines well-known data such as that from the Rothamsted Park Grass Plots. The ideas presented may not be immediately accepted by all ecologists, but they do provide testable hypotheses for the sceptics to reject by experiment. One may not find some of David Tilman's statistics entirely satisfactory, but it is this type of text which enables ecology to make progress through the presentation of innovative ideas for others to test. This book should be on the bookshelf of every serious student of ecology who has wondered why rare species exist and why an ultraefficient 'superspecies' has never evolved.

JEPC

The Ecology of Pests: Some Australian Case Histories, edited by **R. L. Kitching** and **R. E. Jones**. Pp. viii + 254, with many line drawings, figures and b/w plates. CSIRO, 1981.

This is a collection of papers about both plant and animal pests. Many of the examples covered are introduced organisms which have become pests as a result of having no natural predators. Examples of this type are skeleton weed (*Chondrilla juncea*) and the *Sinex* woodwasp (*Sinex noctilio*). The authors of these papers discuss how these organisms have become pests and what measures have been taken to control them. The measures used include chemical and biological type controls as well as an integrated approach. The other examples are naturally occurring pests, such as the arid zone kangaroos (*Macropus robustus* and *Megaleia rufa*) and mosquitoes (*Aedes vigilax* and *Culex annulirostris*). As with most collections of papers written by authors with differing communication skills, the accounts vary tremendously in the clarity of presentation and amount of previous knowledge required to understand clearly the message of the case history. The standard in this case is generally high, but there are one or two of the twelve that let the others down. The coverage of this volume is good and the examples, each with their own lessons for pest control in a wider context, are to be recommended to all who have an interest in the ecology of pests.

JEPC

Grasses and Grasslands: Systematics and Ecology, edited by **James R. Estes, Ronald J. Tyrl** and **Jere N. Brunken**. Pp. 312. University of Oklahoma Press, 1982. $12.50.

A collection of eleven papers presented at a symposium at Oklahoma State University in August 1979. The symposium was seen as necessary to make up for a shortage of papers about grass taxonomy and grassland ecology at other symposia. All the papers have an underlying evolutionary perspective. The volume is divided into two parts. Part I covers the taxonomic topics with four papers on the Triticeae, one on the Poaceae and one of a rather more general nature. As may be inferred from the families considered in this section, the papers all have an applied aspect to them and most are clearly illustrated with diagrams and tables. Part II contains five papers of a profoundly ecological character. Again, these papers are essentially of an applied character, the interaction between grasslands and grazing animals being a major theme. This volume draws attention to the economic importance of grasses and grasslands and points to a paucity of published material, on a worldwide scale, that views these subjects in their evolutionary context.

JEPC

LOSS OF WETLANDS IN SPROTBROUGH PARISH, DONCASTER

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Introduction

Wildlife habitats are being lost and damaged at an increasing rate, and if this continues, the area of semi-natural vegetation in Britain will be halved within a generation (Goode, 1981). Freshwater systems are particularly vulnerable, with the principal threats being intensive land use, drainage and pollution.

There is a need for quantitative data on such destruction and improverishment. Presented here are data for one small area (about 1100 hectares), the parish of Sprotbrough, near Doncaster, South Yorkshire, which was collected as part of an investigation into mobility as a causal factor of rarity in wetland flora (Ulf-Hansen, 1981).

Methods

A survey of Sprotbrough parish sought to identify the approximate date of formation of wetlands. Ordnance Survey maps from the First Series (1851–52) through to 1971–72 and aerial photographs from 1966–68 to 1978–80 provided a continuous monitor of possible wetland formation. However, it was found that no wetlands were created post-1890 and the causes and dates of their disappearance were therefore noted; where possible this information forms the basis of results given here. All still-water bodies were counted, ranging from ponds in old parkland to cut-off canals and field ponds.

Results and Discussion

The loss of wetlands over a period of 117 years from 1850 to 1967 is given in Table 1, which shows extant wetlands and numbers lost over five periods of time. Since the time intervals vary, the percentage rate of loss per annum is given. The table clearly indicates an accelerating rate of loss, reaching 1.23 per cent of sites in the pre- and post-war period to 1967. This represents a total loss of twenty-two wetlands or 65 per cent over the complete period.

TABLE 1

Loss of wetlands 1850–1967, variable intervals, Sprotbrough parish

Year	No. of wetlands extant	No. of wetlands lost	% rate of loss per annum
1850	34	—	—
1890	28	6	0.44
1910	25	3	0.54
1930	22	3	0.60
1967	12	10	1.23

The nature of the loss is illustrated by Fig. 1, which shows the situation in 1850, 1910 and 1967. The fine scatter of sites apparent in 1850 has been markedly reduced, the most recent plot showing only four clusters and a singleton. The trend has been for smaller single wetlands (mostly field ponds) to be eliminated, with the remaining sites being represented by larger water-bodies, often sited in old parkland.

It has been possible to establish probable causes of destruction for fourteen of the twenty-two sites: eight were eliminated due to agricultural land use, either by filling in or drainage, four to urban/residential development, and two to road and rail construction.

The 65 per cent loss of wetlands is broadly comparable to other studies, although the area sampled here is smaller. Ratcliffe (1977) reports a study of the Leicestershire area, where 37 per cent of ponds have been filled in since 1930. For comparison, over the same time period, this investigation yields a figure of 55 per cent. The higher loss for Sprotbrough may reflect the

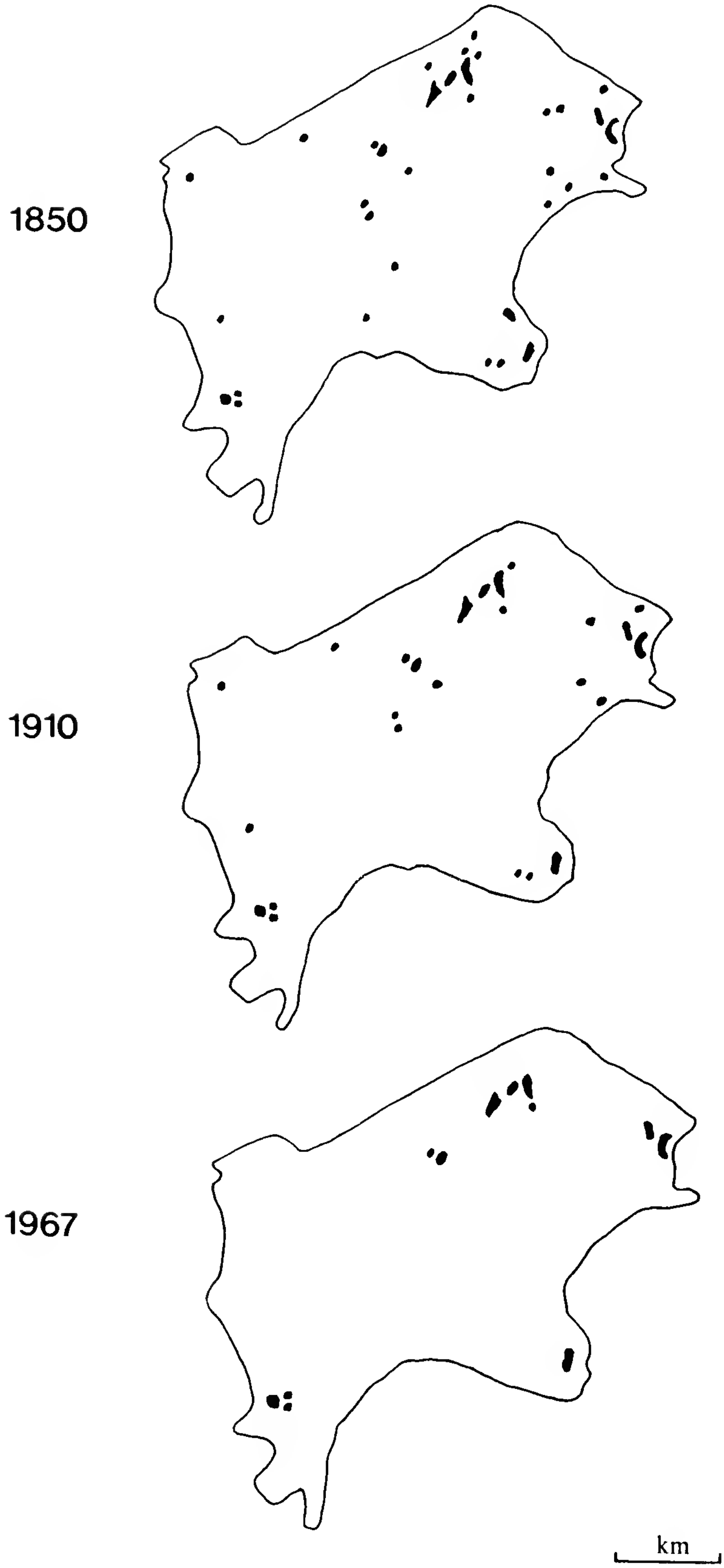

FIGURE 1
Loss of wetlands, 1850–1967, Sprotbrough parish, Doncaster

urbanized nature of parts of the parish. Also in the Leicestershire area, the number of field ponds was reported to have decreased by 50 per cent (Beresford, 1981), although no time period was noted.

These declines show the heavy pressure on such wetland habitats and evidence suggests that other wildlife habitats are equally under threat. Approximate estimates of habitat losses over the same time span as given above were made from figures presented by Goode (1981). These indicate losses of about 30 per cent for Dorset heathlands, Dorset chalk grasslands, and northern mosslands. Goode (1981) also cites evidence of a 30–50 per cent decline of all ancient, semi-natural deciduous woodland over the last thirty years. Small wetlands are thus equally in danger, and Haslam (1975) in fact considers them to be one of the most threatened British habitats. It is to be hoped that the rate of destruction of these and other valuable habitats slows in the near future.

ACKNOWLEDGEMENT

I would like to thank Ms C. A. Lupson for help and encouragement.

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ENTOMOLOGICAL REPORTS FOR 1981–82

R. CROSSLEY

HEMIPTERA

In addition to recording notable discoveries made in the two years under review, this report includes a number relating to earlier periods which were overlooked previously or have only recently come to hand. Of particular interest is Mr Foster's discovery of the mirid bug *Brachyarthrum limitatum* Fieb., which is another addition to the southern element of the insect fauna of the Doncaster area, not having been found previously further north than Suffolk.

The recognition of the variety *lateralis* (Hahn) of *Polymerus unifasciatus* (F.) in 1979 was of national significance and full details have appeared elsewhere (Crossley, R. (1981) *Polymerus unifasciatus* (F.) var. *lateralis* (Hahn) (Hem. Miridae) in Britain. *Entomologist's mon. Mag.* **116**(1980): 155). It is probable that all northern specimens of *P. unifasciatus* are of the variety *lateralis*, the normal form being confined to southern Britain.

Records have been received from Messrs W. A. Ely, J. H. Flint, S. Foster, D. Horsfield, B. S. Nau, T. Potter, to all of whom I express my thanks. In the list which follows new county records are indicated thus † and new vice-county records thus *.

HETEROPTERA

**Macrodema micropterum* (Curt.) (61) Allerthorpe Common, 7/7/82; S.F.

**Plinthisus brevipennis* (Lat.) (63) Sandall Beat, Doncaster, 12/6/82; S.F.
Barnby Dunn, 23/7/82; S.F. Only previous Yorks. record, Cloughton (VC 62), 1924.

†*Brachyarthrum limitatum* Fieb. (63) Wadworth Wood, Doncaster, 26/6/76; S.F.

**Chlamydatus pullus* (Reut.) (63) Balby, Doncaster, 20/8/76; S.F. Only previous Yorks. record, Richmond (VC 65), 1927.

**C. saltitans* (Fall.) (63) Balby, Doncaster, -/7/77; S.F.

†*Globiceps woodroffei* Wag. (63) Thorne Moors, 25/6/67; R.C. Hatfield Moor, 29/6/68; R.C. (61)* Hotham Carrs, 11/7/71; R.C. (All specimens det. late G. E. Woodroffe). Allerthorpe Common, 7/7/82; S.F.

**Orthotylus adenocarpi* (Perr.) (63) Sandall Beat, Doncaster, 26/6/82; S.F.

**O. prasinus* (Fall.) (63) Sandall Beat, Doncaster, 30/6/82; S.F.

**O. tenellus* (Fall.) (61) Jeffrey Bog, Kirkham, 11/7/81; B.S.N. (63)* Sandall Beat, Doncaster, 12/6/82; S.F. The only previous record for this species in Yorks. is for Sandsend (VC 62), 1925.

†*Polymerus unifasciatus* (F.) var. *lateralis* (Hahn) (62) Ashberry, 9/7/78; R.C. (first specimens of this var. to be recognized in Britain). (64)* Timble Ings, Otley, 25/7/78; R.C. Dallowgill, 7/7/79; J.H.F. Records for the nominate form are: (61) Allerthorpe Common, 1932. (62) Hovingham, 1935. (63) Ecclesall, 1921. (64) Askham Bog, 1942. In the absence of specimens these records should now be considered doubtful.

Acetropis gimmerthali (Flor) (61) Allerthorpe Common, 7/7/82; S.F. Only known otherwise in Yorks. at Houghton Wood (VC 61).

The following species are recorded for the first time in the vice-counties indicated but do not call for special comment:

VC 61: *Megacoelum infusum* (H-S)

VC 62: *Gerris lateralis* Schumm.; *Corixa panzeri* (Fieb.); *Sigara falleni* (Fieb.)

VC 63: *Picromerus bidens* (L.); *Gastrodes grossipes* (Deg.); *Xylocoris galactinus* (Fieb.); *Phyllus pallipes* Fieb.

VC 65: *Stalia major* (Cost.); *Heterotoma planicornis* (Pall.); *Stenotus binotatus* (F.); *Capsus ater* (L.).

BOOK REVIEWS

Darwin's Finches by **David Lack**, with Introduction and Notes by **Laurene M. Ratcliffe** and **Peter T. Boag**. Pp. 208, including 8 plates, 27 figures and 32 tables. Cambridge University Press, 1983. £7.25 paperback, £19.50 hardback.

A reissue of *Darwin's Finches* must be welcomed; it is a volume which should never fade into obscurity, marking as it does the state of knowledge in 1944 concerning the evolution of species, and representative of the erudition of a great evolutionary ornithologist. The Prefaces to the two previous editions (1947 and 1961), written by Lack himself, illustrate changing views on matters such as the likelihood that small differences between sub-species are adaptive. The Introduction constitutes a valuable resumé of Lack's contribution, based on careful observation and analysis of pattern, to evolutionary thought in the 1940s. The Notes provide explanations of Lack's work and ideas with modern hindsight. There is a comprehensive list of modern references.

DJH

Genes from the Wild by **Robert and Christine Prescott-Allen**. Pp. 101, with diagrams. Earthscan: International Institute for Environment and Development, London, 1983. £3 paperback.

This Earthscan paperback is a mine of information. It seems to be intended as a source of evidence for those who would argue a case for conservation of wilderness on pragmatic grounds. There are five chapters; the first contains the genuflexion to Mendel mandatory in every elementary genetics text since the first decades of the century. In the remaining chapters many examples of the transfer of genetic material from wild species to crops and domestic animals are given. The costs and benefits of such transfers are discussed; likely recipients of 'wild genes', threats to the existence of such genes, and possible conservation measures are examined. An 'Executive summary' consisting of 41 aphoristic quotations from the text, and a 193-item list of references complete the work. The book contains a few terminological errors (eg, 'a given set of chromosomes is called a genome') and a few meaningless colloquialisms (eg, 'zapping chromosomes with radiation'); it is readable and is probably comprehensible to non-biologists.

DJH

THE BLUE-BOTTLE FLY *CALLIPHORA VICINA* R.-D. AS A PARASITE (PRIMARY MYIASIS AGENT), PARTICULARLY ON SMALL MAMMALS

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INTRODUCTION

The purpose of this paper is to put on record some cases where the common and ubiquitous blue-bottle species *Calliphora vicina* R.-D. (= *erythrocephala* Mg) laid eggs on living woodmice, *Apodemus sylvaticus* L. These cases, together with certain other records of the same blowfly attacking the hedgehog, *Erinaceus europaeus* L., form an ensemble of evidence that suggests the possibility that this blue-bottle species may be a relatively frequent parasite of small mammals, a role that has hitherto virtually escaped detection. The attention of students of small mammals is drawn to this subject in the hope that additional records may be revealed, since it seems probable that this blue-bottle parasitism may occur during a limited time of year, but has escaped attention mainly because the results would be mistaken for the fly's other common activity as colonizer of dead small mammals.

The roles of *C. vicina* in attacking living large mammals (including man) and its well-known occurrence as a secondary myiasis agent of sheep, are reviewed in order to put the above possibility of its importance on small mammals into context.

C. VICINA ATTACKING THE WOODMOUSE AND HEDGEHOG

During September 1982, a group of five or six woodmice were observed to behave in a rather unusual manner at the edge of a piece of waste ground in Boston Spa, West Yorkshire. They seemed to be lethargic and unusually tame, and did not resist being handled. All the mice were immature. One was easily caught by a cat, but another was found huddled in a corner and covered with blowflies of the species *Calliphora vicina* which were ovipositing on the lower back and around the tail. Regrettably the mouse was not captured for further examination as it crept away and, presumably, died as it was not seen again. Lethargic behaviour of this sort has previously been reported in woodmice (Morris, 1968) but, as far as we know, this is the first report of this species being attacked by *C. vicina*.

The European hedgehog has long been known to be the host of a variety of blowfly species. Nielsen *et al* (1978) published a paper on blowfly myiasis in hedgehogs in Denmark. In only five cases did they find that one blowfly species acted alone, three of these being due to *C. vicina*, the other two were due to *Lucilia ampullacea*. *C. vicina* larvae, in the three above mentioned cases, were found in the nostrils, mouth and anus and not in wounds; clearly these were cases of primary myiasis. As in the woodmouse case cited above, all the affected hedgehogs were described as lethargic and immature.

Another relevant observation was the finding of a blowfly parasitized hedgehog near York during October 1980. The animal was not captured however and, therefore, it was not possible to determine the species of blowfly maggot concerned. Collecting records at the time show a total absence of *Lucilia* species in the vicinity; thus it is probable that the parasitizing fly was a species of *Calliphora* in this case. The sites of infestation were the left ear and eye.

C. VICINA ATTACKING SHEEP

Some species of blowflies (Calliphoridae) and flesh-flies (Sarcophagidae) have long been known to act as parasites of larger mammals, causing myiasis (ie the invasion of living tissue by maggots). In warmer parts of the world some species are obligate parasites (eg *Cordylobia* sp., *Auchmeromyia* sp.) that include man as host, while others are facultative parasites that normally confine their egg or larval deposition to wounds on host animals. We are concerned here with a different phenomenon of myiasis caused by oviposition on unwounded domestic animals, usually sheep. This 'sheep-strike problem' occurs in cooler parts of the world, such as Britain. Davies (1934), working in North Wales, found that the green-bottle fly, *Lucilia sericata* Mg., occurred in all 182 cases of sheep-strike that he studied. *C. vicina* accompanied *L. sericata* in

only two of these cases; in all the other cases *L. sericata* acted alone. Later, Ratcliffe (1935), working in Scotland, confirmed these results by showing that *L. sericata* was the only species to emerge from his sheep-strike samples (except in one doubtful record where *C. vicina* was present as well). Experiments by Ratcliffe showed that the larvae of *C. vicina* cannot survive a temperature of 32°C, and he concluded from this that these maggots cannot act as primary strike agents in sheep because the skin and body temperature are much higher than 32°C.

Later work by Haddow and Thomson (1937) and MacLeod (1937) showed that other Calliphorid species could act as sheep-strike agents in Britain, namely *Lucilia caesar* (L.), *Lucilia illustris* Mg., *Phormia terraenovae* R.-D. and (very rarely) *Calliphora vomitoria* (L.). Of the 121 cases from England and Scotland discussed by MacLeod, *C. vicina* occurred in 8 (7 in Scotland and 1 in England); in 2 of the Scottish cases *C. vicina* acted alone. Attempts by MacLeod to produce *C. vicina* strike experimentally in sheep failed, except in one case where the larvae developed and produced a wound, but were confined to the cotton-wool cover of the lesion. He concluded that *C. vicina* was incapable of acting as a primary agent either (a) because the high body temperature of sheep is fatal to the larvae, or (b) that the larvae are unable by themselves to liquefy solid tissue and must depend on the previous activity of *Lucilia* larvae. Of these two alternatives, it would seem that the first is more probable, for the following reasons: (1) *C. vicina* is known to cause primary myiasis in mammalian species with a suitable temperature; (2) the first instar larvae of both *C. vicina* and *L. sericata* are structurally very similar indeed and there seems to be no morphological feature present in *L. sericata* that would facilitate its entry into living tissues. It is possible, of course, that *L. sericata* may release more effective enzymes during extra-oral digestion than *C. vicina*; there is no evidence for this, however.

It is unfortunate that MacLeod's statement that *C. vicina* 'is physiologically unable to act as a primary fly, and it is probable that this species is a true obligatory secondary striker' has been repeated out of context in the literature many times. As it stands it is a statement of universal applicability, whereas MacLeod, like Ratcliffe and Davies before him, was referring specifically to sheep, and moreover to sheep under British conditions.

C. vicina attacking other mammals, including Man

Zumpt (1965) collected many records of *C. vicina* as a myiasis agent. Of these, several were cases of primary myiasis in Man from Libya, one was a cause of urinary myiasis in an old man from Belgium and one was a severe traumatic myiasis in several specimens of the common noctule (*Nyctalus noctula* (Schreber)) from Germany. Another record concerned a captive vervet monkey (*Cercopithecus aethiops* L.); in this case *C. vicina* was the only Calliphorid present, but larvae of the Muscid species, *Muscina stabulans* and *Fannia canicularis*, were also involved. Harvey (1934) reared 114 specimens of *C. vicina* from a farm labourer in England. The patient had undergone several operations following obstinate urethral strictures, and a permanent opening into the bladder was made for extravasation of urine; it is probable that this was the original site of infection. The man died about one month after the first maggots were observed. Cases of intestinal myiasis in babies are also on record (Nuorteva and Auvinen, 1968). Several other cases of human myiasis by *C. vicina* in Britain are known to us from personal experience; permission to publish the details of these cases has not been forthcoming, however. All these cases were from elderly invalids and it is worth pointing out here that, although of minor importance, human myiasis in Britain would seem to be more widespread than is generally supposed.

Discussion

As was noted above, we believe that the low incidence of *Calliphora vicina* 'strike' in sheep is due to the normally high body temperature of this animal. This view is supported by the fact that *C. vicina* does attack small mammals with a lower body temperature. It now remains to review briefly the available information on the body temperature of the mammalian species concerned.

According to Blaxter *et al* (1959, a and b) the rectal temperature of sheep range from 37.5°–41°C at ambient temperatures of 8°–20°C. Skin temperatures, however, show a great range according to whether the animal is shorn or not; thus unshorn sheep have a skin temperature

range of 36.8°–38.7°C at ambient temperatures of 13.4°–36.2°C, while shorn sheep show a range of 26°–40°C at ambient temperatures of 8°–40°C. It should, however, be pointed out that these figures were obtained from experiments conducted under controlled conditions in the laboratory. Under field conditions the effects of wind and rain may well reduce the skin temperatures below the lower limits given above, while direct radiant sunshine may elevate these temperatures.

Regarding *Apodemus sylvaticus*, this species has been suspected to undergo a spontaneous drop in temperature (torpor) during a few hours each day (Walton and Andrews, 1981a). Walton and Andrews (1981b) found that, at an ambient temperature of 23°C, the body temperatures of woodmice, that had been starved for twenty-four hours, dropped from 34°C to as low as 25.5°C (in single mice) and to 26.5°C (in groups of four huddled mice). This phenomenon is quite well-known in a wide range of mammalian species including Rodents, Insectivores and Marsupials. Although daily torpor occurs typically in winter, it also occurs during the autumn months. Furthermore, cases of summer dormancy are known; this latter phenomenon is not fully understood, however (Hudson, 1978). Morris (1968) measured the body temperatures of two lethargic woodmice by placing a thermometer against different parts of the abdomen. He recorded temperatures of 19.5°C and 16.5°C respectively. The ambient temperature was 2°C. Normally active woodmice whose temperature was measured in this way registered temperatures that were never less than 30°C. The two lethargic mice later became active. The temperatures of the woodmice in the Yorkshire case mentioned above were, unfortunately, not measured.

Herter (1965) states that the temperature of hedgehogs will drop to ambient when the latter reaches the critical level of 17°–15°C. This, however, applies only if the hedgehog is physiologically prepared for hibernation. This drop in body temperature reaches 6° or 5° at which point the body temperature of the hedgehog does not drop any further. In the Danish cases mentioned above the temperatures of the hedgehogs were not measured, but the animals were described as being cold and lethargic. These cases were all recorded during August and September 1977.

With regards to the cases of human myiasis caused by *C. vicina* in Britain, patients were all both elderly and unwell (previous to infection). This suggests that body temperature of these individuals was below the normal level, and might explain the attractiveness of these patients to the fly.

It is obvious from the above that *C. vicina* is capable of acting as a primary myiasis agent in mammals with suitably low body temperatures. With regards to sheep, the low skin temperatures recorded by Blaxter *et al* in shorn sheep may account for the occasional case of strike in sheep when conditions are suitable. It is noteworthy that the two cases recorded by MacLeod in which *C. vicina* acted alone were from Scotland where the ambient temperature may have been low. It is also worth repeating Ratcliffe's comment that Scottish shepherds firmly believe that the early season strikes (ie in June) are due to the blue-bottle (*C. vicina*); the green *Lucilia* only appearing later in the season.

Further observations on this aspect of blowfly biology are needed, and any information on myiasis, particularly in small mammals, in Britain would be of great interest.

ACKNOWLEDGEMENTS

We would like to thank Dr Lewis Davies for much useful discussion and for reading and commenting on the manuscript. Our thanks also to Mr Barrie D. S. Smith for sending us his observations and specimens from the *Apodemus* case cited above, and to Dr Nigel Dunstone for his comments.

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BOOK REVIEWS

The Natural History of the Mediterranean by **Tegwyn Harris**. Pp. 224, including numerous coloured illustrations and plates. Pelham Books, 1982. £7.95.

A very attractive little book which will undoubtedly be of interest to all naturalists who visit the Mediterranean region. There are short essays on the natural history of different types of habitat in the region, followed by many pages of illustrations of organisms accompanied by short descriptions of each. The range of organisms covered is comprehensive, from seaweeds through higher plants, jellyfish, worms, molluscs, crustaceans, insects, fish, birds, and mammals. The illustrations are clear and descriptions reasonably precise but in a volume this size they are necessarily only a 'taster', to stimulate those who have a strictly limited knowledge of natural history. Most readers will quickly outgrow the sections covering the groups of most interest to them and turn rapidly to the further reading section to discover where they can get a more comprehensive account. This guide, which covers approximately 1000 species of plant and animal, is therefore recommended as an introduction to the wildlife of this fascinating area.

JEPC

Insect Herbivory by **I. D. Hodkinson** and **M. K. Hughes**. Pp. 77. Outline Studies in Ecology, Chapman and Hall, 1982. £2.75 paperback.

The editors of this series are assembling an impressive collection of small volumes of particular value to students of ecology. The volumes feature clearly-written text and easily understood diagrams. *Insect Herbivory* introduces the reader to those adaptations of both plants and insects which determine the outcome of interactions between them. Woody and non-woody plants are treated separately and the authors then examine the wider contexts of plant community and ecosystem. Having been given a taste for the subject by this excellent introduction, there are no fewer than 222 references for the reader to explore.

JEPC

Y.N.U. BRYOLOGICAL SECTION: ANNUAL REPORT 1982

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EXCURSIONS

The spring meeting for 1982 was held on 1 and 2 May to compile record cards for the British Bryological Society mapping scheme in some under-recorded squares near York. Bolton Percy (VC 64) was chosen as the starting point because of the records of *Myrinia pulvinata* and *Scleropodium cespitans* made during the Y.N.U. meeting of 1943 (Cheetham, 1943). Riparian mosses were found to be frequent in the village, even at some distance from the stream, indicating extensive flooding periodically. *Tortula latifolia* and *Leskea polycarpa* were plentiful, *Homalia trichomanoides* was in small amount, and *Myrinia pulvinata* was found among material of *Leskea* taken home for examination. Another interesting find, at the base of an old stump, was a small quantity of *Radula complanata*, a sensitive epiphyte absent from much of the county and quite unexpected in this part of the Vale of York. *Barbula trifaria* was on brickwork by the stream in an immature form resembling *Gyroweisia* and with the protonemal gemmae recently described by Whitehouse (1980). Other records in the village were *Physcomitrium pyriforme*, and in the churchyard *Tortula intermedia, Orthotrichum anomalum* and *Thuidium tamariscinum*. A brief visit was made to the stone bridge south of the village towards the Ings, and here *Scleropodium cespitans* was present in good quantity, along with *Barbula nicholsonii* and *Orthotrichum cupulatum* var. *riparium*.

None of the remaining sites visited proved as interesting as Bolton Percy. At Hagg Wood, near Copmanthorpe, some common woodland species were added to the card. Later in the year Miss J. Robertson was able to add some ephemerals from this area, including *Riccia glauca, R. sorocarpa, Dicranella staphylina, Bryum violaceum*, and *B. klinggraeffii*. Such species were not much in evidence at the time of the meeting, although *Fissidens exilis* and *Dicranella schreberana* were found in a field by a lane at Scagglethorpe. Redhouse Wood was coniferized and the few bryophytes were almost entirely confined to the rides and dykes. A visit was also made to Moorlands on the eastern side of the R. Ouse (VC 62), where again only common woodland species were present, including *Campylopus introflexus*. However *Pottia truncata* growing as an epiphyte on elder made for the unusual.

The autumn meeting was held near Richmond (VC 65) on 4 September. Much of the time was spent on the wooded banks of the Swale at Hudswell. Rocks by the river were largely base-poor, and had among other species *Blepharostoma trichophyllum, Distichium capillaceum* and *Heterocladium heteropterum*. Close to the water or submerged were *Fissidens crassipes, Cinclidotus fontinaloides, Schistidium alpicola*, and *Hygrohypnum luridum*. The higher parts of the woods had extensive limestone outcrops with some luxuriant bryophyte communities, including *Neckera crispa, Anomodon viticulosus, Rhynchostegiella tenella, Metzgeria pubescens, M. conjugata, Leiocolea badensis, Porella platyphylla, Radula complanata* c. per., and *Lejeunea cavifolia*. The tiny hepatic *Cololejeunea rosettiana* was notably plentiful on the shaded cliffs. The woodland ground flora was also locally luxuriant and included *Hookeria lucens* and *Rhytidiadelphus triquetrus*.

Some time was also spent further to the west, near Downholme. The only additional records of note were *Frullania dilata* and *Tortula laevipila* on an ancient elm, the only species to enliven a surprisingly poor epiphytic flora.

LITERATURE

In her presidential address to the Y.N.U. Mrs J. Appleyard gave a broad survey of Yorkshire bryology (Appleyard, 1982). My own notes have included a report of *Andreaea* in sites near Sheffield and a review of George Stabler's records from Dentdale (Blockeel, 1981a, 1982). There have been the usual sectional and excursion reports.

RECORDS

The most important event during the past year has been the description as a new species of *Barbula tomaculosa*, a moss found in arable fields on the coal measures near Wakefield, Leeds and Rotherham (Blockeel, 1981b). It was discovered by chance in 1978 when its rhizoidal tubers were observed under the microscope in material from a field at Stocksmoor Common. In addition to the published stations (VC 63, 64) it has been found recently in a pasture on millstone grit near Cullingworth (44/03, VC 63), a habitat rather different from the earlier ones. Nonetheless there is a clear preference for moist clayey soil.

The records which follow are believed to be new stations or the rediscovery of old ones.

Riccia cavernosa: (65*) 44/28 Floor of gravel pit, Thorp Perrow nr. Bedale, JR, July 1982.

Riccia huebenerana: (64) 44/17 Moist sandy soil, Gouthwaite, TLB, September 1982.

Sphenolobus minutus: (64) 34/77 Twistleton Glen, Ingleton, TLB, January 1982.

Plagiochila britannica: (64) 34/77 Thorns Gill, Ribblehead, on limestone, TLB, August 1982.

Plagiochila spinulosa: (64) 34/77 Thorns Gill, Ribblehead, on limestone cliff face, TLB, August 1982. More usually found on non-calcareous rock.

Nowellia curvifolia: (63) 44/04 Old logs, North Beck Woods, Keighley, TLB, January 1982.

Scapania scandica: (63*) 34/93 Bank of stream, Crimsworth Dean above Lumb Falls, TLB, January 1982.

Lejeunea ulicina: (64) 34/64 Hodder Banks near Whitewell, TLB & EO, March 1982.

Lejeunea lamacerina: (63) 44/03 Grit rock by stream, Goitstock Wood near Harden, TLB, February 1982.

Sphagnum quinquefarium: (63) 44/04 Among grit rocks, Newsholme Dean, TLB, December 1980; 43/29 Wooded clough, Strines Reservoir, TLB, May 1981.

Andreaea rothii: (64) 34/65 Grit boulder, Slate Delph Clough, Bowland Forest, EO, March 1982; 44/16 Grit rock, Ravensgill, TLB, September 1982.

Archidium alternifolium: (63*) 34/94 Bare ground in pasture near Glusburn, TLB, January 1982; (64) 44/17 Moist sandy soil, Gouthwaite, TLB, September 1982.

Brachydontium trichodes: (64) 44/06 Crumbling grit rock, Ravens Crag, Thorpe, TLB, August 1982.

Dicranella staphylina: (65*) 44/37 Arable field west of Skipton-on-Swale, TLB, December 1981.

Fissidens exilis: (64) 44/43 Woodland floor, near Micklefield, TLB, March 1982.

Aloina brevirostris: (64) 44/43 Disturbed ground on magnesian limestone, Newthorpe Quarry near Micklefield, TLB, March 1982.

Pottia lanceolata: (64) 34/87 Soil in crevice on high Yoredale cliffs, Pen-y-ghent, TLB & EO, April 1982. An unusually high altitude for this species.

Pottia recta: (64) 44/43 Disturbed ground on magnesian limestone, Newthorpe Quarry near Micklefield, TLB, March 1982.

Phascum curvicolle: (64) 44/43 Disturbed ground on magnesian limestone, Newthorpe Quarry near Micklefield, TLB, March 1982.

Barbula acuta: (63) 44/42 Roadside bank on magnesian limestone, near Darrington, TLB, February 1981.

Barbula nicholsonii: (63*) 34/95 Stonework by river, Carleton Bridge near Skipton, TLB, July 1977.

Funaria obtusa: (64) 34/77 Peaty ground, Thorns Gill, Ribblehead, TLB, August 1982.

Ephemerum serratum var. *serratum:* (64) 44/17 Moist sandy soil, Gouthwaite, TLB, September 1982.

Pohlia bulbifera: (64) 44/17 Moist sandy soil, Gouthwaite, TLB, September 1982.

Bryum gemmiferum: (62* & 65*) 44/37 Soil on banks of Swale, Skipton-on-Swale, TLB, December 1981.

Bryum dunense: (64*) 44/43 Disturbed ground on magnesian limestone, Newthorpe Quarry near Micklefield, TLB, March 1982.

Bryum sauteri: (63) 34/94 Soil in pasture near Glusburn, TLB, January 1982.

Bartramia hallerana: (64) 34/77 Wet rock crevice in ravine, Twistleton Glen, Ingleton, one patch only, TLB, January 1982.

Orthotrichum sprucei: (61*) 44/64 Tree base by R. Ouse, Fulford, York, TLB, May 1982; (64)

44/14 By R. Wharfe, Ilkley, TLB, May 1982; 44/35 By R. Nidd, Little Ribston, TLB, June 1982; 34/65 By R. Hodder near Dunsop Bridge, TLB, July 1982.

Orthotrichum pulchellum: (64) 44/35 On elder, Guy's Crag, Nidd banks south of Knaresborough, TLB, June 1982.

Homalia trichomanoides: (63*) 44/13 Tree base by R. Aire, Bingley, TLB, October 1982.

Myrinia pulvinata: (65*) 44/28 By R. Ure, Masham, TLB, July 1982.

Isothecium striatulum: (64) 34/67 Shaded limestone, Swilla Glen, Ingleton, TLB, August 1982.

Entodon concinnus: (64) 44/36 Among grass, Burton Leonard lime quarries, TLB, May 1982.

An asterisk indicates a new VC record or amendment to the *Census Catalogue*. Recorders' initials: TLB = T. L. Blockeel, EO = E. Ormand, JR = Miss J. Robertson.

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FUNGUS FORAYS IN 1981

Spring Foray, Darlington, 7–11 May
Autumn Foray, Whitby, 10–14 September

T. F. HERING

In the spring we used a workroom at Polam Hall School. About twenty of us explored the northern edge of the old county (north-west Yorkshire), and the adjoining part of Co. Durham. Teesdale Nature Reserve was by far the richest site; wet weather and a late spring curtailed the lists from other sites.

The Autumn Foray, attended by twenty-five people, was a return visit to Whitby, where our 1976 foray had been marred by bad weather. Our headquarters and workroom were at the Queensland Hotel. Mulgrave Woods, though much visited in the past, still managed to produce an agaric new to Britain, and two others new to Yorkshire, and there were also new records from Littlebeck Nature Reserve.

I am indebted to Mr W. G. Bramley, Mr P. D. Orton and Dr R. Watling for many of the records below.

LIST OF SITES

Spring	H	=	Hamsterley, NZ/093312
	R	=	Rokeby, NZ/083142
	B	=	Brignall Banks, NZ/077122
	HF	=	High Force, NY/885285 and Sun Wood NY/875282
	D	=	Deepdale, NZ/038168
Autumn	M	=	Mulgrave Woods, NZ/861125
	L	=	Little Beck, NZ/879049
	A	=	Arnecliffe, NZ/785050
	BH	=	Beck Hole, NZ/821025
	G	=	Grinkle Park, NZ/742149
	*	=	new record for Yorkshire

ASCOMYCETES

Ceratocystis ulmi on Elm, L
Chaetosphaerella phaeostroma, D
Cheilymenia stercorea, H
Dasyscyphus pulverulentus, D
Humaria hemisphaerica, M
*Kriegeriella minuta** on Juniper, HF
Leptotrochila ranunculi, A
Linospora capreae, H
Lophodermium juniperinum on Juniper, HF
Melastiza chateri, D
Morchella esculenta, B
Neobulgaria pura, L
Phaeohelotium flexuosum, HF
Rosellinia mammiformis, D
Rutstroemia conformata, D
*Scutellinia subhirtella**, L (new to Britain)

BASIDIOMYCETES

Uredinales and Ustilaginales
Gymnosporangium cornutum on Juniper, HF
*Milesina kriegeriana** on *Dryopteris dilatata*, HF
Puccinia glechomatidis on Glechoma, G
Pucciniastrum vaccinii on *V. myrtillus*, L A
Urocystis eranthidis on *Eranthis hiemalis*, R

Heterobasidiomycetes
Calocera glossoides, M
Dacrymyces punctiformis on Juniper, HF

Aphyllophorales
*Acia membranacea**, M
*Amylostereum laevigatum**, HF
*Basidioradulum radula**, HF
*Ceriporia reticulata**, HF
*Cristella confinis**, HF
*Cristina mucida**, A
*Cylindrobasidium evolvens**, HF D
Fomes fomentarius, M
Hydnum rufescens, L
*Hypochnicium lundellii**, HF
*Phlebia hydnoides**, HF
*P. rufa**, D
*Typhula setipes** on Aspen leaves, HF

Agaricales
Agrocybe brunneola sensu Watling non Lange*, M
A. praecox, H
*Amanita punctata** (Cleland) Reid, L
*Armillaria ostoyae**, A
*Bolbitius titubans**, A
*Boletus appendiculatus**, M
B. porosporus, M
B. spadiceus, A
Chamaemyces fracidus, M
Clitopilus hobsonii, M
C. pinsitus, M
Conocybe brunnea, A

Coprinus cordisporus on rabbit dung, H
Cortinarius armillatus, L
C. pseudosalor, L
C. rigidus, L
Entoloma sordidulum, A
Flammulaster aff. *carpophiloides**, D (possible new species)
Galerina ampullaecystis, D
*Hebeloma fragilipes**, A
Hygrophorus chrysaspis, M
H. strangulatus, A
*Inocybe leptocystis**, M
I. obscura, M
I. petiginosa, G
Lactarius chrysorrheus, L
L. cyathula with Alder, A
L. glaucescens, L
L. hepaticus, L
L. obscuratus, L A
L. pterosporus, BH G
L. volemus, A
Leccinum holopus, L
Lentinellus cochleatus, A
Leptonia babingtonii, A
Marasmius hudsonii, A
M. recubans, A
M. wynnei, A
Mycena rorida, L
M. tortuosa, L
Naucoria luteolofibrillosa, M
Nolanea tenuipes, L
*N. versatilis**, A
Oudemansiella nigra Dörfelt*, M (new to Britain)
*Pleurotus pulmonarius**, L
Psathyrella albidula, B
P. obtusata, HF
*P. pannucioides**, HF (new to Britain)
Russula curtipes, L
R. densifolia, L G
*R. illota**, L
R. laurocerasi, M L A
R. puellaris, A
R. subfoetens, M G
Tubaria autochthona, M
T. conspersa, HF
T. pellucida, D
Tricholoma saponaceum, A
T. sciodes, M

FUNGI IMPERFECTI

Bispora antennata, M
Cytospora rhododendri on *Rhododendron*, R
C. taxi on *Taxus*, HF
Monilia aurea, M
Ovularia obliqua, M
Ptychogaster albus, M

Other interesting records in 1981:

Albugo tragopogonis (Pers.) S. F. Gray on *Senecio vulgaris*. This parasitic fungus resembles the widespread 'white blister' of cruciferous plants, with white spores in pimple-like pustules. Long known on *Tragopogon*, it was unrecorded on groundsel in Britain until 1981, when Mr W. G. Bramley found it near Pickering. Later it was found near Leeds, and in Notts. and Leics. Experiments reported from Sheffield in 1978 by Whipps and Cooke (*Transactions of the British Mycological Society*. **70**: 389–392) showed no infection of groundsel by races from *Tragopogon*. Dr S. M. Francis (Commonwealth Mycological Institute, Ferry Lane, Kew, Richmond TW9 3AF) is interested in further reports of this newcomer.

*Peronospora lepigoni**

*Albugo caryophyllacearum**. These two parasitic fungi were recognized by Dr Francis on material of *Spergularia maritima* from Barmston (VC 61).

FIELD NOTE

Dewberry — Raspberry hybrids

My colleagues Dr S. C. Clark and Dr D. D. Bartley recently observed near Pickering, VC 62, a colony of *Rubus caesius* × *idaeus*. The plants were intermediate between the two parents, with arching stems, white undersides to the leaves and red fruits with few drupelets. In Stace's 'Hybridisation and the Flora of the British Isles' (1975: 201) this hybrid is cited by A. Newton for only six English vice-counties, VC 62 being one of those listed. In answer to my enquiry Mr Newton has kindly informed me that his entry for VC 62 was based on a personal field record made near Helmsley in 1975 and that he has since seen the hybrid both in VC 61 near Malton and in VC 63 near Maltby. So far as I am aware this hybrid has not previously been reported in our annual botanical records from any Yorkshire locality.

W. A. Sledge

BOOK REVIEW

Fungi: Folklore, Fiction & Fact by **W. P. K. Findlay**. Pp. 112, including 13 monochrome plates. Richmond Publishing, 1982. £4.75 soft covers.

This book is essentially a pot-pourri of anecdotes and quotations relating to man's interactions with these fascinating organisms throughout history — both the problems they have posed and the pleasures he has derived from them. The text, which is divided into eleven short chapters commences by sampling the writings of the Greeks and Romans, progresses to those of the herbalists and then gives accounts of fairy rings, witches butter and luminous fungi, of ergotism and of dry rot. There follows a chapter dealing with the sexual connotations of some fungi (chiefly Phallus and its allies) and then a compilation of quotes from poetry and fiction of more recent times. The book then turns its attention to our consumption of fungi for nourishment, and the occasional poisonous consequences. It concludes with an introduction to the history of hallucinogenic fungi in general, and devotes its final chapter to the particular case of the fly agaric.

Although offering some light-hearted background observations on fungi which may delight the natural historian, the book as a whole is a disappointment. The exposition of most topics are too cryptic to be satisfying, teasing rather than informing; yet this short text abounds with blank pages, spaces and rather arbitrary whole page illustrations. A six-page index has been appended and yet the reader who wishes to delve further into the subject is fobbed off with a mere eight-entry bibliography. The latter does at least include reference to J. Ramsbottom's excellent *Mushrooms and Toadstools* in the New Naturalist series, where most of this subject matter is treated in a more scholarly and thorough fashion, and to which the reader would more profitably direct his attention.

AB

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Edited by M. R. D. SEAWARD, MSc, PhD, DSc, FLS, The University, Bradford

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WALTER GARSTANG (1868–1949): ZOOLOGICAL PIONEER AND POET

R. A. BAKER
University of Leeds
and
R. A. BAYLISS
Robert Gordon's Institute of Technology, Aberdeen

> 'He certainly looked more like a real scientist. He was untidy and always wore rough tweeds and heavy boots.'

This was Leo Walmsley's description of Garstang as he saw him at Robin Hood's Bay around 1914 and in marked contrast to the neat and precise Alfred Denny, professor of Zoology at Sheffield (Walmsley, 1969) Garstang spent twenty years as a marine biologist before he came to Leeds University as its first Professor of Zoology and never lost his love for the sea or his association with it.

Walter Garstang, born in Blackburn, Lancashire on 9 February 1868 was the eldest son of a medical practitioner of wide intellectual interests who had seven children. The descendants of Walter (1832–1899) and Matilda Mary Garstang, and the bequest for a lecture trust in Blackburn set up by members of the family, are described in a book by one of their daughters (Gurney, 1970). Like his brothers, Walter junior was educated at Queen Elizabeth's Grammar School, Blackburn and later spoke of its candle-lit interior (Garstang Family, 1956). The school's Garstang room and portrait commemorate a notable Blackburn family. Walter Garstang went up to Jesus College at 16½ years of age in 1884, followed later to Oxford by his two younger brothers. John, the youngest brother, became Professor of Archaeology at the University of Liverpool.

Henry Nottidge Moseley who had sailed on the Challenger expedition (Deacon, 1971) and was Linacre Professor of Zoology and Comparative Anatomy in the 1880s, and E. B. Poulton, the entomologist, were significant influences and friends at Oxford and later (Carpenter, 1945).

He graduated in 1888 in Natural Science, having abandoned an earlier intention to read medicine and after a nervous illness probably caused by excessively hard work and going up to university at a very young age (Hardy, *pers.comm.*).

Plymouth

With the support of a number of leading scientists, the Marine Biological Association was founded in 1884. Garstang began his career at Plymouth a week before the opening day of the new marine laboratory in 1888 at the invitation of Gilbert Bourne. His entry into marine science was described in an unpublished and most unfortunately lost, autobiographical manuscript (Hardy, 1951 A):

> 'Fifty years ago, on June 21, 1888, having taken up my degree at Oxford in the morning, I journeyed to Plymouth, picking up the old broad gauge express at Swindon, to begin duty as Secretary and Assistant to the Director of the newly founded laboratory of the Marine Biological Association.'

Garstang went on to describe the last minute preparations for the opening ceremony, including his first meeting with Ray Lankester, 'the man who was largely to rule my destinies and those of most other young zoologists, for the next twenty years'.

A diary kept by Garstang gives an early view of his many pastimes: he was involved in the YMCA and church activities, played the piano and violin, was interested in literature, concerned about his health, had doubts about his faith and was hoping for a demonstrator's post

at Oxford. He refused an offer to work at the British Museum. One comment reveals something of the excitement of discovery.

> '17 January 1889. What abundance of life on every bit of rock near low water — enough to last a man a good ten years hard work and then he would say only "Omnia exeunt in mysterium!"'

Bourne left Plymouth after two years and Garstang unsuccessfully applied for the directorship. In the customary printed application (Garstang, 1890) he described his work as 'secretary, sub-librarian and scientific assistant', together with ideas on economizing on the small staff and enclosing the usual supporting testimonials.

Publications at this time included his first paper on nudibranchiate mollusca (Garstang, 1889). In 'Notes on the marine invertebrate fauna of Plymouth' (1892) Garstang made reference to the practical problems never far from under-funded scientists. He wrote that the 'frequent breakdowns of the small and antiquated launch belonging to the Association seriously interfere with the continuity of our work'. It has been suggested in the memoir of a Director at Plymouth (Kemp, 1943) that there were substantial financial difficulties. A vivid account of the laboratory including Garstang's own work was written in 1899 (Crossing, 1900).

In 1891 Garstang was appointed to a Bishop Berkeley Fellowship at Owens College, Manchester (Thompson, 1886). The fellowships were inspired by the research work of Johns Hopkins University, Baltimore.

Garstang was fortunate to work with Arthur Milnes Marshall, Professor of Zoology, whose scientific achievements were complemented by enthusiastic extra-mural teaching (Kelly, 1950). Marshall (1893) referred to Garstang as 'one of the brightest and most enthusiastic naturalists I have ever come across; a man devoted to science for its own sake'.

Oxford

After a brief return to Plymouth, Garstang was elected to a fellowship at Lincoln College, Oxford, in 1893 and a lectureship the following year, but he retained his links with Plymouth by visiting the marine station in the summer months. He was supported, amongst others, by W. A. Herdman, who declared that Garstang had been 'one of the most promising young zoologists' who had 'that fertility of resource . . . so necessary for the successful investigation of scientific problems'.

Poulton, who had already published an account of Garstang's researches (Poulton, 1890), wrote to Garstang advising him to go to Lincoln College and added that 'I feel sure that Miss Ackroyd would agree with my advice' (Poulton, 1893). Lucy Ackroyd of Newnham College, whose family home was in Bradford, had met Garstang at Plymouth and later married him in 1895.

Garstang lectured at Lincoln and Jesus Colleges, worked with Lankester and lectured in extension classes. Garstang's letter to Michael Sadler, then Secretary of the Oxford Extension Delegacy, explained his view that certain branches of zoology were especially suitable for extension classes, 'chiefly those which deal with animals themselves as living creatures rather than their minute organization'.

Lincoln College was small and a historian has recently described it as being in the 'complacent afternoon of the Indian summer of the late Victorian age' (Green, 1979). Although Garstang was the only scientific fellow, he enjoyed the friendship of a notable senior colleague, William Warde Fowler, classical scholar and ornithologist, who was an important influence in developing in the 1880s the practice of systematic observation of wildlife with 'notebook and a first class telescope or field-glass' (Allen, 1978). Fowler was co-editor with Louis Miall, Garstang's predecessor at Leeds University, of an edition of Gilbert White's *Natural History and Antiquities of Selborne* (Miall & Fowler, 1901). It is clear that Garstang had a great affection for Fowler. In *Songs of the Birds*, Garstang (1922 A) included a dedication, in the form of a poem, 'as a memorial of my debt to him'. The lines included:

'Three things old friend in youth revealed
With you are interwoven,
A common room, rich walks afield,
Rare evenings with Beethoven.'

Garstang's association with Plymouth continued. The first vacation classes were started by him in 1895 when he took a group of Oxford students there.

It was during his period as Fellow and Lecturer at Lincoln that he first propounded his ideas on the ancestry of vertebrates. 'My theory postulates a common ancestor for the Echinodermata, the Enteropneusta and the Chordata (Garstang, 1894) and emphasizes the value of functional as well as structural considerations in matters of phylogeny' (Garstang, 1897 A).

Garstang visited Toronto in 1897 to attend the British Association meeting. A letter written on the voyage (Garstang, 1897 B) included a characteristic comment on a distant view of the Isle of Man, the sighting of Herdman's laboratory at Port Erin, with 'high ground inland suggesting capital walks and invigorating breezes'. He arranged to collect plankton with the help of the captain and wrote that 'I shall be able to collect a complete set of samples with no difficulty at all.'

Garstang returned to Plymouth in 1897 as Naturalist in charge of Fishery investigations. In his final years at Plymouth important moves were underway as the fisheries industry of Europe was 'jostled from its thousand year slumber' (Schlee, 1973). Technological change, notably in the application of steam power and later motor power, had led to international co-operation with a series of important conferences in Scandinavia. Garstang attended the second International Conference for the Exploration of the Sea at Christiania, Norway in 1901 with another notable scientist, D'Arcy Wentworth Thompson (Mill, 1902). F. Nansen and J. Hjort were the Norwegian delegates.

The International Council for the Exploration of the Sea, founded in 1902 as a result of the second International Conference, brought together a distinguished group of scientists including Johan Hjort, Fridtjof Nansen and C. G. J. Petersen. Garstang later wrote to Hardy about his friendship with Hjort and his 'admittance to the Viking fraternity' (Hardy, 1951 B). He became convenor of what was initially called the Over-Fishing Committee from 1902 to 1907 as part of a complicated programme of both hydrographical and biological work of eight European nations (Schlee, 1973). Britain supported this work and the Scottish Fishery Board and Marine Biological Association organized the scientific work.

When W. C. M'Intosh, a pioneer in marine biology, occupant of the University chair in Natural History at St Andrew's and an authority on Scottish fisheries, published his book on the 'Resources of the Sea' in 1899, he claimed that the sea fisheries were inexhaustible. This view received much criticism and 'the most trenchant criticism came from Dr Walter Garstang' (Gunther, 1977). Garstang took the opposite view, suggested in the title of his paper, 'The Impoverishment of the Sea', published a year later, in which he was led to the conslusion 'that the bottom fisheries were not only not inexhaustible, but in rapid and continuous process of exhaustion; that the rate at which sea fishes multiply and grow, even in favourable seasons, is exceeded by the rate of capture' (Garstang, 1900).

M'Intosh used Huxley's earlier claim in supporting evidence, but Garstang was quick to point out that Huxley had included the phrase 'in relation to our present modes of fishing'. Clearly M'Intosh took no account of the immense advances in the powerful sea trawlers built in the 1890s and much of the basis of his book was subsequently questioned.

Lowestoft

In 1902 a new laboratory was established at Lowestoft, and Garstang began there a productive period, described as 'those classical investigations into the natural history of the North Sea plaice which have laid the foundations of English fishery research' (Hardy, 1951 A).

A steam trawler was bought by another important marine scientist, G. P. Bidder, and leased to the Association, one of several acts of generosity (Gray, 1972). The appropriately named *SS Huxley* was equipped with cabins in the fish hold and a laboratory on deck and in an account entitled 'Down in the deep — the romance of fish life', Garstang described the work of catching, measuring and 'tagging' fish with the discs devised originally by C. G. J. Petersen (Garstang Family, 1902). He conceded, no doubt ironically, that the fish would be 'lopsided' but otherwise unharmed. Fishermen were to be paid for returned specimens.

The Lowestoft laboratory was not lavishly housed, occupying for years a little white fronted

shop in Waveney Road. 'From here the North Sea investigations work was directed between 1902 and 1906 when a tiny staff moved to a house in the Marina. In this building . . . was set up the first internal semblance of a laboratory' (Atkinson, 1955).

Garstang's team caught and freed large numbers of plaice, studying natural growth rates and migrations. Experiments in transplantation pointed clearly to the benefits to be gained in increased growth by moving plaice to richer feeding grounds. The establishment of the International Council at which Britain stressed above all the importance of studying over-fishing made this revival of fishery research essential. The over-fishing subject involves studies on the reproduction, migration and growth of fish and until these investigations were carried out at Lowestoft there was 'no exact knowledge applicable to the fishing grounds' around our coasts (Garstang, 1906).

Accounts of the work were published by the International Council and in Government publications (Garstang, 1905, 1909 B, 1909 D). His own revealing comment in his application for the Oxford chair in 1921 makes clear his feelings: 'The sequel (to the International Conference of 1901) is well known . . . although few zoologists appear to have realized what it meant to carry on one's regular work of investigation and at the same time maintain almost single-handed, a steady pressure towards the goal in sight with fluctuating counsels behind, active and relentless opposition in front and cross currents of intrigue and misrepresentations constantly at work . . . I would add simply that the programme drawn up by Hjort, Heincke and myself in 1901, the policy I advocated and the results achieved under my direction have long been accepted as the basis of organized fishery investigations in this country and have placed the utility of Marine Zoology, especially on the Bionomical side, outside the pale of controversy.' From 1902 to 1908 Garstang was scientific adviser to the British delegates to the Council and convenor of the International Committee on trawling investigations.

Hardy's point (1951 A) that Garstang 'felt he would never be happy if he was not entirely free to shape his own policy' echoes Garstang's own views. One might speculate that Garstang was not happy in handling the particular mix of politicians, civil servants, industrialists, and scientists in fisheries research. As Hardy (1950) put it in an obituary, 'Garstang was an individualist, a lover of freedom and independence, who resented what appeared to him to be government interference in his scientific programme when official policy did not coincide with his own plans.'

Leeds

The Board of Agriculture and Fisheries was about to extend its control over fishery investigation when Leeds University decided to create two new departments and professorial chairs of botany and zoology to replace the biology department headed by L. C. Miall, who had held the foundation chair since 1876 (Baker & Bayliss, 1983). In 1910 the Fisheries Department eventually took over and the laboratory at Lowestoft was dismantled while the research vessel *Huxley* was sold by the Marine Biological Association.

In a letter to the Vice-Chancellor at Leeds, Garstang (1907 A) wrote 'I earnestly wish to resume academic work' and two days later wrote to Miall that 'several of those upon whom I should have depended for support are now no more — Professor Moseley, Weldon, Howes, and Milnes Marshall, but several of my friends, though embarrassed by the late announcement of my desire, have promised to write on my account' (Garstang, 1907 B). Garstang wrote to Bodington, the Vice-Chancellor, again, after his interview amplifying his proposals for research: 'The important fisheries carried out from Hull and Scarborough seem to me to show that an expansion of the present field of biological research carried out at the college in the direction of the sea fisheries would be legitimate.'

He was however conscious of the needs of the whole area, not just the coastal fisheries and went on: 'I should therefore propose, if elected, to devote my first year to making myself acquainted with all the branches of biological activity at present underway, or contemplated, while winding up my own reports on past investigations' (Garstang, 1907 C).

Garstang, with an Oxford DSc awarded in 1906, was a candidate in a very strong field (University of Leeds, 1907 A): Ernest MacBride, already a professor at McGill and an FRS (Calman, 1941) was to play a significant part later in Garstang's life. Edwin Goodrich, also an FRS by 1905, later occupied the Linacre chair at Oxford for which Garstang competed (De Beer,

1972). F. W. Gamble FRS had been a Berkeley fellow at Owens (Hickson, 1927) and J. S. Gardiner, later appointed Professor of Zoology at Cambridge, had worked at Naples and was an authority on corals (Forster-Cooper, 1948). He also was later to become an FRS.

The committee on the biological chairs resolved to report to the Council that 'the Chair of Zoology should be offered to Dr Garstang and the Chair of Botany to Mr Blackman and that to each chair should be attached a fixed salary of £550 a year' (University of Leeds, 1907 B). Garstang's success may have owed something to the Vice-Chancellor's former links with Lincoln College. His background in applied research was thought to be one of the reasons for his appointment (Yonge, *pers.comm.*). He had by 1907 some fifty publications and was well known at Oxford and Manchester, and on parliamentary committees and international forums. It may be noted that the successful Professor of Botany, Vernon Herbert Blackman (1872–1967) became a distinguished plant physiologist and left Leeds for Imperial College in 1911. Garstang (1935) wrote of 'being brought to anchor in an inland town, away from the sea which had hitherto absorbed my interest'.

The immediate task was to create a new department in a small university only a few years old, with limited advanced work and no students engaged in advanced zoology.

With a staff of three, transferred from the previous biology department, including a 'keeper of the insect collection', he began to build up his new activities. Garstang's predecessor, Louis Compton Miall, was well known as an entomologist (Baker & Bayliss, 1983). In the University annual reports, the work is outlined. For 1908–1909 there was a note of research 'for a large part of their vacations' and publications listed for Garstang and a new member of staff, Marie Lebour, who later worked for many years at Plymouth (University of Leeds, 1909). Marie Lebour went to Plymouth in 1915 on temporary 'loan' and remained there nearly fifty years (Russell, 1972). She was a friend of the Garstang family and later worked with Robert Gurney, Garstang's brother-in-law. In 1910 Garstang's investigations into insect colours and markings were reported, with Lebour's vacation work at the Millport and Cullercoats marine stations and a significant reference to a student engaged on an honours course (University of Leeds, 1910).

An important part of the University's work was the education of teachers. One Saturday morning course was held in the session 1912–13. Students were asked to provide 'a few simple instruments' and the more squeamish were advised that there would be 'dissections rare and optional'. There were also summer vacation courses at Bingley Training College, and Garstang later described his work to 'overcome the ill-considered antagonism of the Board of Education to the encouragement of Zoology in schools', confirmed in Jenkins' (1979) detailed analysis of science in education.

In University affairs, Garstang was involved in a number of activities. He continued his early interest in rowing by supporting the University Boat Club and was prominent in the Officers' Training Corps. He was Dean of the Faculty of Science (1917–1921), Pro-Vice-Chancellor (1929–1931) and claimed to have undertaken a 'more than average share of administrative duties'. This was an important stage in the development of the University: Yorkshire College had received its charter on 25 April 1904 and by the 1920s had developed the early technological bias by a broader range of subjects. Most of the students were reading for degrees, including postgraduate work, and the First World War not only brought a later influx of more mature students but also substantial encouragement of research (Gosden & Taylor, 1975).

In the First World War, Garstang did not go on active service but was a machine-gun instructor and was later commissioned in the volunteer battalion of the West Yorkshire Regiment. He also visited France in 1918 to lecture on zoological and educational topics to the troops, arranged through the YMCA and Army GHQ, France. Garstang noticed what he believed to be a mistake in a memorandum which stated 'The primary object of the lectures will be the raising of the morals of the troops' and found that 'morale' was intended. He later wrote in his diary 'Imagine my disappointment when I was told that I was marked down for the convalescent camps in the Trouville area, not up the line. My subject was supposed to be interesting enough to entertain the wounded but not pointed enough for the front line men — for that you must be talking on "War Aims".' His lecture titles included camouflage and mimicry, North Sea Fisheries, birds and their songs and the social life of animals (Garstang, 1918).

Garstang (1919 A) wrote of Oxford contemporaries who died in the Great War, including Edward Minchin, a protozoologist of note and Arthur Darbishire, Edinburgh University's first genetics lecturer.

An important part of Garstang's work was the support he gave to amateurs and their societies. A former student later commented, 'He never isolated himself from the outside world . . . he stimulated the interests of the amateur biologists of Yorkshire' (Eastham, 1949). In 1921 he wrote 'Throughout my residence in Leeds I have endeavoured to revive the waning interest of the public in Zoology by stimulating the work of local Natural History and other Societies, in the course of which I have given a great number of semi-popular lectures up and down the Ridings on various aspects of animal life. I have also on several occasions conducted long vacation courses in Natural History upon the invitation of the West Riding Education Authority at the Bingley Training College. Some may deny the value of such work as involving a diffusion of energy, but for my part I am convinced that in my present position it has been a duty.'

At Plymouth he had been one of the founders and first President of a local Field Naturalists' Club and was a past President of the Norfolk and Norwich Naturalists' Society. His presidential address read in March 1905 was on 'The natural history of the North Sea' (Garstang, 1909 A). He joined the Yorkshire Naturalists' Union and wrote for *The Naturalist* (Garstang, 1909 C, 1919 C, 1920). He was President in 1918 and his address on 'Nature and Man' (Garstang, 1919 B) was an interesting and wide ranging one. He thought that the 'mantle of the prophet is passing — indeed has already passed — from the poet to the man of science'. He concluded: 'In my opinion the future welfare of humanity depends more upon the training of the sentiments and emotions in the light of a knowledge of nature than upon anything else.'

In the same journal thirty years later, Henson (1949) in an obituary wrote 'This was the first of his writings betokening a rapidly widening interest in terrestrial natural history and a rapidly developing artistic appreciation of nature. With Professor Priestley, Garstang also helped to revive the fortunes of the Leeds Naturalists' Club by providing a home and bringing its members into closer contact with the University (Donnan, 1951). The Leeds Philosophical and Literary Society also had scientific interests. Garstang's contributions included the presidential address on 20 October 1925 on 'Wordsworth's Interpretation of Nature' which appeared as a Supplement to *Nature* (Garstang, 1926 B).

What was initially called the Yorkshire Universities' Marine Laboratory, and more recently the Wellcome Marine Laboratory (now closed and sold) had originally been a joint venture of the Universities of Leeds and Sheffield. Garstang in 1912 persuaded the University to rent part of a row of buildings adjacent to the slipway as a combined laboratory-living cottage for student field studies at Robin Hood's Bay. The buildings were purchased in 1922, 'a good investment if nothing else said the University Surveyor' (undated typescript, Wellcome Marine Laboratory, Box 1–A2 History & Development, University of Leeds Archives). His main connection with living marine animals during his period at Leeds was through this laboratory. He first visited the village at Easter 1909 with T. H. Taylor, then one of his lecturers, and Ll. Lloyd, a student. Lloyd (1949) later recalled the occasion — 'We stayed at the Bay Hotel and its verandah, the sea washing its walls at high tide, was our laboratory.'

Apart from the work at Robin Hood's Bay and the links with Plymouth, Garstang became a member in 1919 of the Scientific Advisory Committee on Fishery Research of the Development Commission established in 1909 where he initially sat with G. C. Bourne and E. W. MacBride. He wrote articles for *The Times* (Garstang, 1926 A) on the effects of the Great War on fishing stocks and gave the Buckland lectures in 1930 at Grimsby and Hull. Garstang referred to the potentialities of a North Sea 'great fish farm', which only awaited more knowledge before it could be cultivated rather than exploited. 'So far it must be admitted it is a farm in which Nature has done all the sowing and man only the reaping.' He envisaged the future prediction of fishing stocks using 'knowledge of physical and planktonic conditions'. 'The subsequent history of fishing in Northern Europe has yet to point to an easy solution of what are now old problems' (Garstang, 1930).

Garstang's musical and literary interests were expressed in various ways and especially as part of an interest in bird song. A reviewer of his book 'Songs of the Birds' in *Nature* noted the 'welcome reaction from the too mechanical conceptions that are common but there is at the

same time some danger of their leading towards too anthropomorphic ways of thinking'. The reviewer decided not to comment on the verse. Another reviewer in *Ibis* commented that the book 'makes an appeal to all bird lovers, but it is a difficult book to analyse'. Garstang lectured extensively on the subject. A report in *The Daily News* (7/1/1922) describes a lecture on bird song to the Parents' National Educational Union in London. 'Professor Garstang relied upon his own vocal powers when his supply of gramophone records ran out.' He was able to articulate the sounds of almost all the British song birds. Garstang's verse was also written in light hearted parodies like 'The Students' Opera' (Garstang, 1922 B). He also wrote verse for more serious scientific argument and to illustrate his ideas on evolution 'for in truth he often made his points with greater force in his light hearted verse than in his more technical scientific prose' (Hardy, 1956). He found some of these were not acceptable to the editor of *Nature*. Gregory (1922) wrote 'I do not think they are at all comparable with your poems on Bird Songs' and in another letter he quoted the comments of a referee: 'unless this sort of thing is exquisitely well done, with delicate rhymes and real wit in the allusions, it oughtn't to be done at all.'

Walter Garstang on the shore at Robin Hood's Bay.
(Photograph by courtesy of Dr H. Henson)

Retirement

Garstang retired in 1933. *The Gryphon* referred to his 'sailor's breeziness' and 'his happiest classes . . . on the shore at Robin Hood's Bay' (Lloyd, 1933). A colleague, H. Henson (1974), commented on his autocratic style as head of department and on an attitude towards letters that will strike a sympathetic chord with many, 'If you leave them long enough they answer themselves.' The Zoology Department had grown, and by 1933 Garstang had a staff of five including a Reader, Llewellyn Lloyd, who had been the first research student in the department.

Garstang's enthusiasm for scientific investigation did not diminish with age. He published major works long after his retirement and he retained a close working friendship with Robert

Gurney. Gurney never held an official position but worked continuously in his private laboratory, first in Norfolk, then in Oxford, his speciality being decapod and copepod crustacea. Garstang went to Bermuda twice, in 1935 and 1938, with Robert Gurney and wrote with excitement and enthusiasm to his wife of the 'discovery of a most amazing globular larva' (Garstang, 1938). He later found the larva had already been described as the genus *Planctosphaera*. Correspondence with discovery staff at the British Museum in 1948 (Totton, 1948) and the draft of a paper (Hardy Collection) show that Garstang was still working on the description of a new species when he was eighty years old.

Two contributions to the Zoology reports of the 'Terra Nova' discoveries appeared after his retirement, one with Elizabeth Georgeson, a former PhD student (Garstang, 1934; Garstang and Georgeson, 1935).

Garstang attended a Linnean Society discussion on bird song on 10 February 1949, and died on 23 February in Oxford.

The obituaries included one by a former student, Leonard Eastham (1949), who became Professor of Zoology at Sheffield, who paid a tribute to work done at Leeds:

> 'Great as were his contributions to marine zoology, both academic and economic, zoology was the gainer by this change. For his virile mind was thereby released to pursue the philosophical and speculative tasks for which he was so patently fitted. He inspired them (the students) with a love for the subject and . . . made them think and see for themselves. Few who go from us will leave behind so much affection and such a sense of gratitude.'

Other obituaries described him as a 'kindly, sympathetic, highly cultured English gentleman' (Henson, 1949); 'a great teacher' (Hardy, 1951 A); as a man who when obliged to fight 'thoroughly enjoyed it' (Hardy, 1950).

These and other memories echo the earlier words of Michael Sadler (1921):

> 'He is young in mind and is in sympathy with young men. From him they and their elders catch the infection of a love for nature and an exact and appreciative observation of the habits and beauty of living things.'

The University of Leeds commemorates his memory in the name of the Garstang student flats and in the Walter Garstang Fund administered by the Zoology Department to give financial help to 'meritorious students working in the area of marine or freshwater biology and in particular to enable undergraduate students to attend vacation courses at the Plymouth laboratory'.

Assessment of Garstang's Work

Garstang's scientific work may be divided into several broad areas. The first twenty years were very productive in a branch of science under rapid development. He worked with distinguished scientists and made a notable contribution. His studies in invertebrate marine biology at Plymouth and Oxford from 1888 to 1897 led to twenty-nine papers mainly on the morphology, ecology and distribution of marine animals and in this, the first phase of his working life:

> 'He made delightful studies on the habits and life of nudibranchs, he did early experiments with fish, on the theory of warning colourations . . . and studies on the burrowing crab *Corystes*' (Hardy, 1973).

For the next decade he carried out pioneer work on fishery research at Plymouth and Lowestoft, which provided a scientific basis for the analysis of fishery problems. Working particularly in the field of bionomics on the races and migrations of the mackerel and later on the plaice, his studies included transplantation experiments on fish, ocean currents, the artificial rearing of sea fish, investigations of the plankton, the physical conditions in the English Channel and the impoverishment of the sea. Recent work using enzyme electrophoresis tentatively suggests that Garstang's work on races of mackerel was 'ahead of its time and probably correct' (Southward, *pers.comm.*). His own accounts of what was achieved are necessarily brief and do not give a full story of years of difficult work by scientists of many nations in an atmosphere of political complication and in an industry of sturdy independence. An obituary (*The Times*, 1/3/1949) said of this period:

> 'He was the moving spirit in the development of English fisheries research . . . a pioneer in bringing about the International Council for the Exploration of the Sea

> . . . (and carried out) classical investigations in the Natural History of North Sea Plaice.'

Before he was forty he had achieved more than most might do in a lifetime of scientific work but these fundamental investigations were in some ways to be overshadowed by what was to come. It is in the field of evolutionary theory that he is perhaps best remembered for his speculative and controversial ideas. Two words predominate in any assessment of his contribution to zoology — Recapitulation and Paedomorphosis.

Many zoologists believe that Garstang's (1922 C) paper on 'The Theory of Recapitulation' was his most important contribution. Henson (1974) described it as 'one of the most intellectual accomplishments from the Department of Zoology at Leeds'. The 'Biogenetic law' first put forward by Haeckel in 1866 had been revived by MacBride (1914) in his *Textbook of Embryology*. Garstang attempted to re-define the foundations of the law, the basis of which he believed to be unsound. In playing a major part in the downfall of Haeckel's theory he came into direct conflict with MacBride (1926). Corresondence in *Nature* later, highlighted their differences when a series of letters on Natural Selection contained these sentences: 'the confusions and obscurities in Professor MacBride's recent letter' (Garstang, 1929 B) and 'Professor Garstang's letter appears to me to be trivial' (MacBride, 1929). De Beer, however, was one of the first to recognize the contribution that Garstang had made; referring to the theory of Haeckel, he stated 'we are rid of a mental straight-jacket which has had a lamentable effect on biological progress' (De Beer, 1940). A more modern synthesis of Garstang's views and their full significance for evolutionary theory are reviewed by Hardy (Huxley, Hardy & Ford, 1958). In the same 1922 paper, Garstang first introduced his own term Paedomorphosis (like a child) to describe the prolongation of the early phase of development into sexually adult life. He used this as the basis for his theory of evolution. It was almost the direct opposite of the biogenetic law. Gould (1977) describes this contradictory process: 'Recapitulation requires that adult features of ancestors appear in the juvenile stages of descendants. Nothing therefore can be more contrary to its operation than the incorporation of previously juvenile features into the adult stages of descendants.' He also believes that Garstang by writing in the context of evolutionary theory 'revised by Mendelian genetics . . . regarded paedomorphosis as orthodox . . . (and) assured the downfall of recapitulation'.

Garstang was the first to look for traces of the ancestors of the vertebrates in early instead of adult stages of invertebrates; and he focussed his attention on the larvae of Echinoderms (De Beer, 1940). J. Z. Young (1981), referring to Garstang's theory of vertebrate ancestry, believed it to be 'necessarily speculative but it has certain strong marks of inherent probability.'

Three other important papers by Garstang appeared later. In his presidential address to the British Association Zoology Section in 1928 on 'The origin and evolution of larval forms' (1929 A) Garstang again put forward his speculative views on the course of evolution, ending with an old German saying, 'Behaupten ist nicht beweisen,' meaning that to assert something is not to prove it and asked his audience to throw the windows of the mind open. In the same year he gave that address, he published his paper on 'The morphology of the Tunicata and its bearings on the phylogeny of the Chordata' (Garstang, 1928) in which he developed in greater detail the theory he first proposed in 1894 'that the Chordates were derived by paedomorphosis from the pelagic larval form of sedentary invertebrates' (Hardy, 1950). Finally, three years before he died, he published 'The morphology and the relations of the Siphonophora' (Garstang, 1946), a long paper which prompted a worker at the British Museum to comment 'a masterly digest of Siphonophore literature . . . am filled with admiration' (Totton, 1948).

Garstang maintained his interest in larval forms and evolution throughout his life. We can gain some idea of how Garstang himself viewed his theories: in a typed draft of his proposed work on 'Larval Forms', Garstang intended to quote on the front page from Victor Franz's *Geschichte der Organismen* (1924) the following:

> 'One cannot deny that Goethe often had a very shrewd judgment on morphological principles, just because he did not depend on dominant theories, but sought himself independently to find in Nature how she presents herself.'

There seems little doubt that Henson (1974) was right when he said that Garstang 'was a much greater zoologist than he was normally given credit for'. Gould (1977) describes him as 'an excellent functional biologist'. However, Garstang's attack on Haeckel's law brought him into

direct conflict with some of the very influential zoologists of his time. The absence of the highest academic honours and also the honours bestowed by Governments may be partly explained by this.

Garstang's scientific stature is still a matter of controversy. He was not elected to a fellowship of The Royal Society and several people close to him have suggested that personal animosity may have been partly the reason. Some people did not take his phylogenetic speculation seriously. Evolutionary studies of this kind were being replaced by more experimental methods using modern techniques in zoology and speculation as to the origin of different groups of animals was becoming old fashioned. Lloyd (1933) referred to the subject as 'that zoological country of lost endeavours where the backboned emerge from the backboneless'. There is also the absence of substantial written scientific work for many years after his arrival at Leeds. The poetry, sometimes written with serious intent, but often as doggerel as an aid to student learning, might have been too slender a vehicle to draw substantial attention and may have counted against him. The attempt to capture bird song on paper could be interpreted as a brave attempt, but unsatisfactory in its results and unacceptable to the specialists in animal behaviour. With regard to honours and The Royal Society Fellowship, it has been suggested that Garstang, because he had worked on a wide range of research topics, was not identified with a special subject, 'But there was also a bias against "fisheries" which was regarded as "trade", not pure science' (Southward, *pers.comm.*).

History is concerned with the recoverable past. In an analogy particularly relevant to the study of a marine scientist, Lytton Strachey wrote of the biographer who could 'row over that great ocean of material and lower down into it, here and there, a little bucket, which will bring up to the light of day some characteristic specimen' (Briggs, 1965). Many interesting questions remain unanswered because the material is not there to be dredged. Garstang's own account would have been of great value to this brief assessment of his life and work and a larger scale evaluation is clearly necessary.

Garstang was 'a poet and a lover of nature' (Hardy, 1950) and a 'zoological entertainer' (Garstang, 1951), and there can be no doubt that he was also what the *Challenger* seamen would have called him — a philosopher.

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NOTE

A complete bibliography has not been attempted but Alister Hardy's list of works in *Larval Forms* (1951) contains over 100 titles and Garstang's published papers, extensive use of which have been made here, are in three bound volumes held in the Edward Boyle Library at the University of Leeds.

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Y.N.U. BRYOLOGICAL SECTION: ANNUAL REPORT 1983

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In April the British Bryological Society held its spring meeting for 1983 in Ilkley and excursions were made to characteristic sites within the Dales. Many of the notable bryophytes of the region were seen, and although most of the localities were bryologically well-known, three species were added to the flora of VC 64. The autumn meeting of the Section was held at Skipwith on 3 September, principally for a visit to the Common. Fuller reports on both these meetings are being published elsewhere.

Records

Although a number of scarce epiphytes appear in the records which follow, there is no evidence that such species are recovering lost ground in Yorkshire. Most of them occur in small quantity and have a tendency to occur only on ancient tree boles, suggesting that at least some species have difficulty in colonizing younger trees.

Marchantia alpestris: (63*) 44/13 Pavement outside the Parish Church, Bingley, July 1983; (64) 44/25 On path, Harlow Carr Gardens, Harrogate, July 1983. This taxon, formerly considered a variety of *M. polymorpha*, may prove to be common as a weed.

Metzgeria fruticulosa: (64*) 34/77 On elder near the Viaduct, Batty Moss, Ribblehead. The segregate *M. temperata* appears to be commoner in western Yorkshire, though both species are rare.

Calypogeia trichomanis: (64) 34/77 On peat, below Meregill Head, Ingleborough, July 1983.

C. muellerana: (61*) 44/63 On wet peat, Skipwith Common, Sept 1983.

Anthelia julacea: (64) 34/77 Still present on wet millstone grit rocks, with *Campylopus atrovirens*, at Meregill Head, Ingleborough, July 1983.

Lophozia perssonii: (64) 44/42 On soft magnesian limestone in small ancient quarry between Ledston and Ledsham, near Castleford, Dec 1982.

Barbilophozia hatcheri: (64*) 34/87 On limestone ledge on the high cliffs, Pen-y-ghent, M. E. Newton, Apr 1983 (B.B.S. Excursion).

Jungermannia caespiticia: (64*) 44/16 On moist gritty soil on bank of stream, Upper Skell Gill,

Sept 1983. This is a nationally rare species which was found to be not uncommon in parts of Calderdale by H. Walsh in the post-war years, but otherwise appears to be a great rarity in Britain.

Marsupella sprucei: (64*) 34/76 On Silurian rock east of Wharfe village, Dec 1982; 34/78 In small quantity on millstone grit at *c.* 1750 ft alt., Force Gill, Whernside, Oct 1983.

Cladopodiella francisci: (61*) 44/63 On peaty sand, Skipwith Common, Sept 1983.

Cephaloziella elachista: (61*) 44/63 Skipwith, W. Ingham, 1899 (MANCH) (*Bull. Br. bryol. Soc.* **42** (1983): 48).

Frullania fragilifolia: (64) 34/77 On sheltered rock face, Crummackdale, Feb 1983.

Brachydontium trichodes: (64) 34/76 On Silurian rock east of Wharfe village, Dec 1982.

Campylopus subulatus: (64) 34/67 Among Ingletonian rocks on grassy bank near Thornton Force, Ingleton, Feb 1983.

Leucobryum juniperoideum: (64*) 44/05 On millstone grit boulder near the Strid, Bolton Woods, T.L.B. and M. O. Hill, Apr 1983 (B.B.S. Excursion).

Fissidens crassipes: (61*) 44/73 On stonework at water level, Derwent Bridge, Bubwith, Sept 1983.

Fissidens celticus: (64*) 34/77 Bank of stream in ravine, Twistleton Glen, Ingleton, July 1983. New to Yorkshire.

Tortula virescens: (64*) 34/96 Sycamore by the Village Green, Linton, Wharfedale, A. Newton, Apr 1983 (B.B.S. Excursion).

Hyophila stanfordensis: (63) 44/41 On earth at base of limestone cliff, woodland north of Wentbridge church, H. L. K. Whitehouse, Apr 1983.

Pottia recta: (64) 44/42 Magnesian limestone pasture between Ledston and Ledsham, near Castleford, Dec 1982.

Barbula ferruginascens: (64) 34/77 Soil among rocks, Studrigg, Crummackdale, Feb 1983.

Coscinodon cribrosus: (64*) 34/77 On dry slate rocks in old quarry, Twistleton Glen, Ingleton, T.L.B. and E. Ormand, Jan 1983, and with fruit, T.L.B., July 1983. A rare species, previously known in Yorkshire only from the famous *Mielichhoferia* site in Cleveland.

Discelium nudum: (64) 44/14 On clay-with-shale bank near top of Shipley Glen, Eldwick, Sept 1983.

Tetraplodon mnioides: (64) 34/77 Plentiful and in fine fruit on old sheep dung, more rarely on bones, among grit boulders, Combe Scar, Whernside, June 1983.

Bryum riparium: (65*) 34/69 Amongst dripping shaley scree on bank of stream running into Cautley Spout, 580 m alt., west of Cautley Crag, A. R. Perry, 1969 (*Bull. Br. bryol. Soc.* **42** (1983): 54). New to Yorkshire.

Zygodon conoideus: (64) 34/77 On elder, Clapdale, Dec 1982.

Orthotrichum stramineum: (64*) 34/97 On sycamore by R. Wharfe, Hubberholme, Apr 1983; 34/96 on elder by roadside near Netherside Hall, Threshfield, May 1983.

Orthotrichum rivulare: (64) 34/95 Tree root by R. Aire, Coniston Cold, Feb 1983.

Ulota phyllantha: (64*) 34/74 Old willow by R. Ribble, West Bradford, Jan 1983; 34/96 On elder, riverside woodland, Netherside Hall, Threshfield, May 1983.

Leucodon sciuroides: (64) 34/97 On old ash tree by R. Wharfe near Hubberholme, Apr 1983.

Neckera pumila: (64) 34/97 Base of alder overhanging R. Wharfe, near Hubberholme, Apr 1983.

Brachythecium salebrosum: (64*) 44/14 Wet *Molinia* dominated grassland, Baildon Moor, E. Newton and L. Warburton, Nov 1983 (Cliffe Castle, Keighley).

Except where stated otherwise, the records are my own. An asterisk indicates a new vice-county record or an amendment to the Census Catalogue.

Corrigendum

The moss reported as *Ditrichum pusillum* in the report of the Y.N.U. Meeting at Bedale and Thorp Perrow (*Naturalist* **108** (1983): 153) has since been examined by several bryologists and the consensus of opinion is that it is a form of *Dicranella varia*. In particular it lacks the characteristic rhizoidal tubers of the *Ditrichum*.

THE STATUS OF THE MOUNTAIN HARE, *LEPUS TIMIDUS*, IN THE PEAK DISTRICT

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INTRODUCTION

There are three principal herbivores on the Peak District moorlands, domestic sheep, Red Grouse *Lagopus lagopus* and Mountain Hares *Lepus timidus*. Sheep are enumerated by the agricultural census taken in June each year; there were about 143,000 in the moorland parishes in 1976 (Yalden, 1981), though not all of these would be actually on the moorland, as some would be on lower pastures. The Red Grouse population has been estimated at about 10,000 pairs (Yalden, 1979). An earlier paper on the Mountain Hare, *Lepus timidus*, based on 163 sightings, described the distribution of the species, but made no attempt to estimate the population size (Yalden, 1971). As a result of continued fieldwork, it is now possible to attempt this, as well as re-examine the distribution.

METHODS

Field survey records are assigned to 1 km squares of the national grid, with altitude and vegetation type being noted. The most important fieldwork has been carried out in March or April, when the hares are still white but the moorlands are often bereft of snow. To obtain one estimate of the population, the highest count obtained in each one kilometre square, at any time in the past sixteen years (1967–1982), has been taken as the population size in that square. In addition to my own fieldwork, Sheffield-based naturalists have been studying the species (Clinging, 1982; Clinging & Whiteley, 1980; Whiteley & Whiteley, 1976). A regular 'Mountain Hare Watch' undertaken one day in March each year to survey the population along the eastern edges has produced higher counts than my own for some squares, and I have used the highest available figure. Another estimate has been obtained by calculating the average density per 1 km square, and multiplying that by the total number of squares in which the species has been recorded.

It was noted that Mountain Hares tend to gather on steep rocky slopes (Yalden, 1971) and that this made it easier to count them. The converse of this is that hares on flatter moorland might be overlooked, and the population thus underestimated. In an effort to investigate this point further, on some of the field trips in the last three years I have been accompanied by a Labrador dog which certainly has a 'good nose' for hares and rabbits. Because of the regulations covering 'Access Land', it has not been possible for the dog to roam freely.

RESULTS

The present paper is based on 1090 sightings of my own, accumulated during 222 field days; Sorby Natural History Society (Sheffield) hare watches recorded between 58 and 161 hares each year.

The distribution map resulting from this fieldwork (Fig. 1) is similar to the earlier one, but rather more extensive; in 1971, the species was recorded from 106 squares, whereas it is now recorded from 246 squares. The Mountain Hare has spread slightly further south down the eastern moors on Burbage Moor (cf. Whiteley & Whiteley, 1976), but the major change is the larger population in the north-west. As well as the two main areas of population mentioned before, covering the Hayfield-Kinder Scout area and the eastern edges (Yalden, 1971), there is now a third area around Arnfield and the Chew moors. Mountain Hares are now regularly seen, though they are sparse, on the Holme Moss-Black Hill plateau (cf. Yalden, 1971).

Numerically, the eastern edges, between Derwent Edge and Outer Edge, continue to be much the best area for the species, with 60 per cent of the population located in the 10 km squares SK18, SK19 and SK29 (Table 1).

There is still no evidence that Mountain Hares occur on Comb's Moss, Goyts Moss, Danebower, or Eyam Moor at present, though all these areas have been revisited by myself and other naturalists. Since they were reported in these areas by earlier naturalists (Coward &

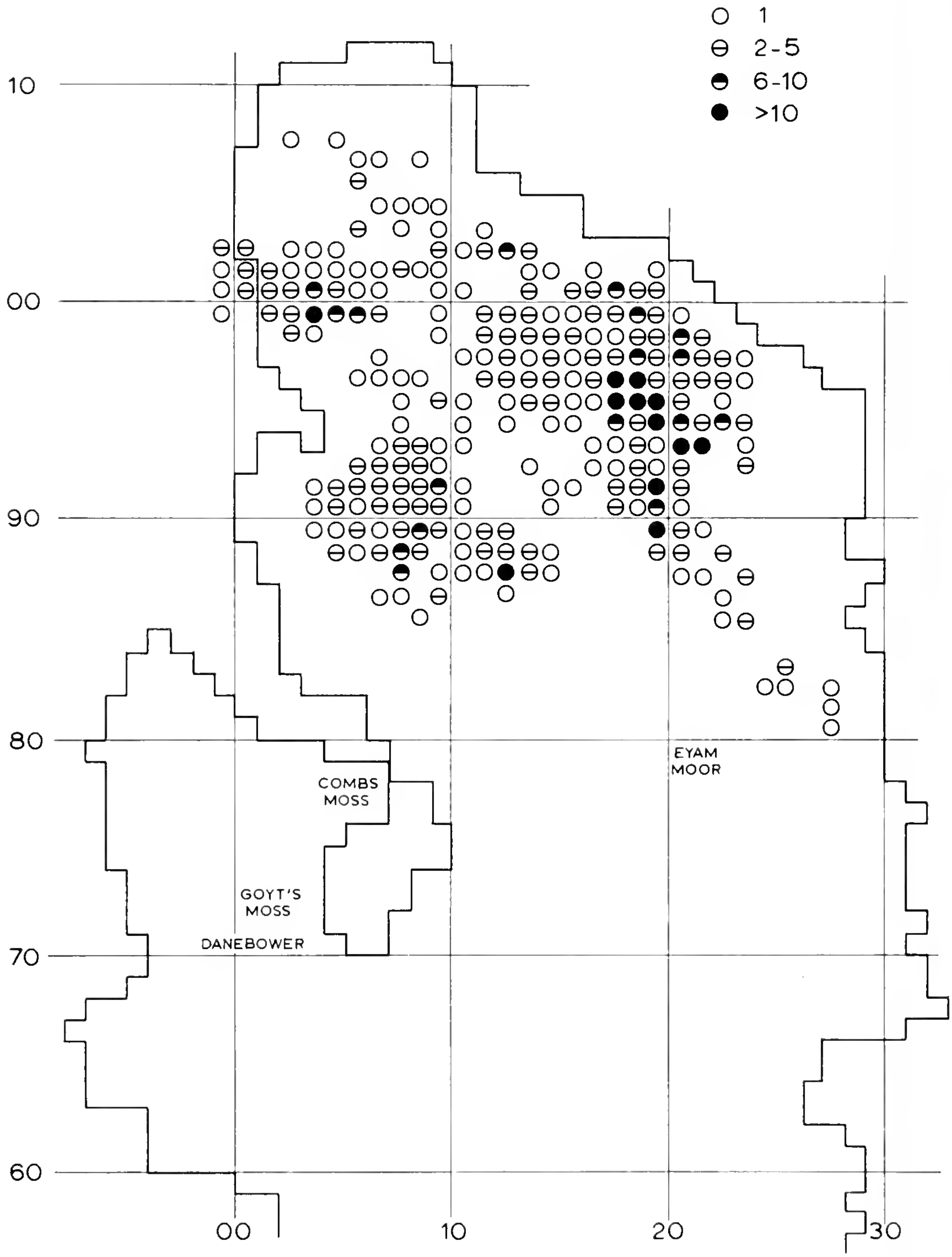

FIGURE 1
Distribution and abundance of mountain hares, *Lepus timidus*, in the northern part of the Peak District, plotted by 1 km squares of the national grid. The heavy outline represents the boundary of the Peak District National Park, and the graticule the 10 km National Grid squares.

Oldham, 1910; Stubbs, 1929; Hewson, 1956), they must, as suggested earlier (Yalden, 1971), have become extinct locally — all these are rather isolated, southern, patches of moorland in the Peak District, and it would be difficult for Mountain Hares to colonize or recolonize them from further north.

The population estimate derived by summating the highest count in each 1 km square is 735 animals. The species is, of course, highly clumped; in 112 squares, nearly half the total in which it was recorded, the highest count was only one hare, but conversely, 24 hares were seen in the most populated square, and there were 23, 22 and 19 hares recorded in three further squares (Table 1). The average number per square (for squares in which at least one hare was recorded) was 2.1, with the figure in different years ranging between 1.4/km^2 (in 1979 and 1980) and 3.3 km^2 (in 1977). The number seen per day's fieldwork (again, considering only days on which

TABLE 1

Number of mountain hares *Lepus timidus* seen

(a) in the 10 km squares (of the national grid) contributing to the Peak District

(b) the frequency distribution of 1 km squares by the number of hares seen in them

(a) 10 km grid squares		(b) 1 km grid squares	
Square	Hare numbers	Number of hares per square	Number of squares with that many hares
SD 90	4	1	112
SJ 99	1	2	58
SE 00	59	3	18
SE 10	39	4	16
SK 09	104	5	12
SK 08	56	6	5
SK 19	274	7	5
SK 18	61	8	6
SK 29	115	9	2
SK 28	22	13	3
Total	735 hares	14	4
		15	1
		19	1
		22	1
		23	1
		24	1
		Total	246 squares

at least one Mountain Hare was seen, and only years with at least ten days' fieldwork) varied between 2.2 (in 1980) and 9.4 (in 1975), with an overall average of 4.9 (Table 2).

Multiplying the average number seen per square (2.1) by the total range (246 squares) gives a population estimate of 517, ie roughly 500. This method of estimating the population can also be used to give some idea of the variation from year to year. In 1979, only 45 hares were seen in 32 squares, a density of 1.4, suggesting a total population of 344 hares; conversely, in 1977, with a survey density of 3.3 hares/km^2, the implied population was 819 hares (Table 2).

The limited amount of fieldwork with the dog did not suggest that I was overlooking any large proportion of the hare population. Together we visited 48 squares, and saw a total of 84 Mountain Hares. The highest counts in those same 48 squares totalled 170 hares. I was only aware of the dog detecting three or four hares which I might have missed, an error of perhaps 5 per cent; conversely, my height allowed me to spot many more which she did not detect.

Discussion

Summing the maximum number of hares seen in each 1 km square suggests a total population of 735 Mountain Hares. Without attempting a mark-release-recapture programme, it is impossible

TABLE 2

Variation in sightings of Mountain Hare *Lepus timidus* in the Peak District from year to year

Year	Total hares seen	No. squares	Mean No. per square	No. days fieldwork	Mean No. per day	Popn. estimate
1967	1	1	1.0	1	1.0	246
1968	14	9	1.6	4	4.7	394
1969	15	11	1.5	7	1.7	369
1970	82	51	1.6	21	3.9	394
1971*	114	63	1.8	26	4.4	443
1972*	95	41	2.3	11	8.6	566
1973*	113	49	2.3	19	5.9	566
1974	35	18	1.9	13	2.7	467
1975*	178	55	3.2	19	9.4	787
1976	10	3	3.3	2	5.0	819
1977*	112	34	3.3	16	7.0	819
1978*	52	24	2.2	11	4.6	541
1979	45	32	1.4	17	2.6	344
1980	60	44	1.4	27	2.2	344
1981*	77	40	1.9	16	4.8	467
1982*	87	33	2.6	12	7.3	640
Total	1090	508	2.1	222	4.9	517

* years in which the eastern edges were surveyed adequately.

to judge how reasonable this is as a population estimate, but one can attempt to evaluate the magnitude and direction of the errors.

Firstly, this method must inevitably lead to an increase in the estimated population as fieldwork progresses; hares are seen in further squares, or higher numbers in some squares, so the estimate goes up, but never goes down. When I did the same analysis at the end of 1977, I estimated 622 Mountain Hares. Thus 735 is likely to be an overestimate. Furthermore, this method of estimation implies that the population is stable from year to year.

It is also likely that the estimate is higher than it should be because the hares certainly move round in response to weather, particularly wind conditions, as Flux (1970) also reported. With a strong west wind, the hares are spread on the east side of the Derwent Edges, whereas in an east wind they gather in the rocks of the steep west-facing scarp slope. The same individuals could thus easily be counted in two, or more, squares; this could not happen undetected on any one day, but could easily happen between successive trips.

It should also be noted that the figure refers essentially to the late winter population, because that is when the hares are easiest to count, and when the most successful fieldwork has been undertaken. Since most mortality occurs over winter (Flux, 1970), one would guess that the autumn population might be twice the size of the March one.

The highest total of hares seen in any one year in my fieldwork was 178 (in 1975), and the highest count in the Sorby NHS counts was 161 (in 1977). Since it is not possible to cover the whole of their range in one year, these figures suggest that 200 is an absolute minimum population estimate. The median estimate, of about 500, suggested by multiplying the average survey density by the total number of squares in which the species has been seen, is perhaps the best one. This method of estimating the population also allows some judgement of the variation in population from year to year, but there are problems with this method too. Because one can only sample part of the range each year, the estimated density is bound to reflect the sampling. In particular, if the dense population on the eastern moors is not sampled, or only poorly sampled (as was the case in 1979), then the survey density, hence the population estimate, will be low. If the estimate of 735 is an overestimate because of the 'stage-army' effect, one might nevertheless expect the autumn population to be rather higher, perhaps 1000 individuals.

Clearly, the species is much less common than the Red Grouse (10,000 pairs. perhaps 60,000 birds in August (Yalden, 1979)).

As potential prey for various predators, and as consumers of heather, the two species differ in their ecological impact by an order of magnitude. The hares also have much less impact than sheep on the grazing.

Summary

The highest number of Mountain Hares seen in the Peak District in each of 246 one km squares over the period 1967–1982 has been summed to give a population estimate of 735 individuals. This number refers to the late winter, minimum, population. A minimum figure of 200, a median of 500, and an autumn, high, population of perhaps 1000 are suggested.

Acknowledgements

I thank Derek Whiteley for making available to me the detailed counts made on the Sorby Natural History Society's 'mountain hare watches', and Mrs P. E. Yalden for accompanying me on much fieldwork.

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BOOK REVIEWS

Mammals of Britain and Europe by **Richard Orr** and **Joyce Pope**. Pp. 176 with numerous colour plates and b/w drawings in text. World Wildlife Fund & Pelham Books. 1983. £14.95.

This is an account, species by species, of the biology of the mammals of Europe. The text provides information on such aspects as size, geographical distribution, feeding habits, behaviour, habitat, economic status, reproduction, and conservation status. In some instances several species are dealt with in one section, e.g. squirrels, bats, shrews, although the text clearly distinguishes between the species within the grouping. Finally, there is a short section on observing Europe's mammals and tracks and droppings.

The most striking feature of this book is the high quality and lavishness of Richard Orr's excellent illustrations. There are many colour drawings of species which are supplemented by numerous small drawings, mainly but by no means exclusively in black and white. These illustrate details of anatomy, behaviour, habitats, locomotion, and general biology. This is artwork of a quality to be compared with Archibald Thorburn's illustrations to Millais's work on British Mammals which appeared at the beginning of this century. Orr's style is different, being more meticulous and detailed. The work as a whole contains within its relatively limited size a

profusion of illustration which gives the reader considerable insight into the behaviour and appearance of Europe's mammals. The representation is generally very good, although here and there one has reservations. Are the fox and red squirrel really as red as this and don't the wood mice faces look a little blunt? This is a work to be thoroughly recommended to anyone interested in or wanting to know more about European mammals.

MJD

The Northern Yellowstone Elk: Ecology and Management by **D. B. Houston**. Pp. xx + 474 with 85 figures. Macmillan. 1982. $48.00.

The elk is better known to naturalists in this country as the red deer. The account is centred around ten years' research by the author on the scientific management of elk in Yellowstone National Park. During the course of this work Houston reappraised some of the established ideas on elk management; he questions the need to cull as a method of preventing habitat deterioration, considers the past role of burning and advocates the reintroduction of the wolf into the Park. This is a refreshing, stimulating and scientifically penetrating account of scientific management of a wildlife resource. It is inevitably limited to a particular location, although some of the broader concepts put forward merit consideration in a broader context. The main text is a solid scientific study supported by no less than 245 pages of appendices. Surprisingly, there are few comparisons with the studies on the management of this species in Europe. A useful addition to the wildlife manager's library.

MJD

Seabirds: an identification guide by **Peter Harrison**. Pp. 448 including numerous maps and line drawings, plus 88 pages of colour plates. Croom Helm. 1983. £15.95.

This magnificent book, specifically designed for field identification of seabirds, is the result of the author's researches over the past seven years, during which time he travelled extensively throughout the world, drawing, photographing and studying the world's seabirds.

In a brief introductory chapter, he discusses the key diagnostic features and main problems involved in identifying seabirds. He does not pretend that seabird identification is easy. The plates, which illustrate the main plumages of all species and distinctive subspecies, precede the main text, but are provided with facing captions summarizing the main features to be observed in the field; symbols indicate regions where the birds are likely to occur. The order is not strictly taxonomic, since similar-looking species are occasionally included on the same plate, and where this is not possible they are cross-referenced but not, unfortunately, by plate number. Some plates are over-crowded, e.g. Skuas, Plate 54, but nevertheless, they are still far superior to those provided in any other seabird guides.

The Systematic section, which forms the main body of the text, is well arranged for use in the field, and contains such information as detailed descriptions of the various plumages, flight, habits and jizz, distribution and migration, and similar species. More awkward groups and identification problems are most competently handled. The maps, in a separate section at the end of the book, are well drawn and use different scales according to the range of a species.

There are few criticisms to be levelled at this book, but perhaps the inclusion of some non-seabirds (e.g. Grebes resident in the Andes and Central Madagascar) is unnecessary, and the somewhat skimpy section on seaducks, which are well covered elsewhere, could have been omitted altogether. A few typographical errors have been detected, such as the text-reference on the plate illustrating Bulwer's Petrel which is mis-referenced to Herald Petrel. However, these are only minor criticisms and the book will undoubtedly become a standard reference work, essential for anyone interested in seabirds.

TSC

A Key to the Adults of the British Ephemeroptera with notes on their ecology by **J. M. Elliott** and **U. H. Humesch**. Pp. 101, including numerous figures and tables. FBA Scientific Publication No. 47. 1983. Available from: Freshwater Biological Association, The Ferry House, Far Sawrey, Ambleside, Cumbria LA22 0LP. £4.50.

As well as detailed keys to forty-seven mayfly species, complemented by helpful line drawings, there are sections on the general characters, classification, collection, ecology, behaviour, egg development, etc. and a useful reference list (145 items).

LICHEN FLORA OF THE WEST YORKSHIRE CONURBATION — SUPPLEMENT III (1981–83)

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The programme of fieldwork continues, making the West Yorkshire conurbation one of the most intensively studied urban lichen floras in the world. Detailed monitoring is called for, since the flora is at present critically affected by changing environmental conditions brought about by atmospheric amelioration as noted by Seaward (1981).

A complexity of factors is involved: changes in pollution regimes affect a wide variety of important lichen substrates in terms of their acidity. Implementation of the Clean Air Acts of 1956 and 1968 on the one hand has resulted in the occurrence of lower acidic levels in urban substrates of long *in situ* standing, brought about by rainwash and leaching (substrates of recent origin being influenced to a lesser degree), whilst on the other hand, outer suburban and rural substrates have experienced reverse effects due to acid rain caused by the more widespread dispersal of gaseous pollutants (Likens *et al*, 1979; Press *et al*, 1983). Acid rain needs fuller consideration in future analyses of lichen floras.

Numerous examples of lichen recolonization of the ameliorated urban environment can be cited; for instance, foliose plants (*Hypogymnia physodes*, *Parmelia saxatilis* and *Physcia* spp.), not seen on trees in inner Leeds for many decades, are now colonizing mature *Fraxinus* within the University campus (44/2934; see Henderson, 1984); and *Lecanora muralis*, here as in many other localities within the conurbation, is now colonizing siliceous substrates after generations of confinement to calcareous habitats. In many suburban roads and streets *L. muralis* extensively occupies the moister microhabitat provided by paving immediately below walls, fences, gates, and hedges. Its invasion is almost certainly assisted by diaspore propagule trapping on walls, etc. and by bird-lime enrichment of such sites, with bird transport of diaspores and subsequent downward rainwash.

Young plants of *Xanthoria parietina/aureola* (the two species difficult to differentiate when young) can now be found as very loosely scattered chains of generally dull yellow-gold thalli, at numerous calcareous sites within the inner conurbation, penetrating much further into this area than they previously did, even as isolated occurrences (see Fig. 1). Improvements like these are not evident on substrates in areas which suffered most intensely from pollution in the past, for instance, trees and exposed walls in the eastern and southern parts of the conurbation.

The geology of the conurbation (Seaward, 1975: p. 153) presents substrates vulnerable to acid rain with consequent effects on natural drainage systems and, hence, on aquatic lichens. It is of interest, therefore, to note the record of *Verrucaria elaeomelaena* (see below), which brings the number of aquatic lichens recorded within the conurbation in recent years to four; only one of these, *V. hydrela*, has been recorded from the inner conurbation.

The record of *Leptogium turgidum* (see below) brings the number of gelatinous species known in the conurbation today up to four. Interestingly, all are on anthropogenic substrates: on old garden walls (*Collema crispum*, *Leptogium plicatile* and *L. turgidum*) and on park or garden paths (*Collema crispum*, and *C. tenax* vars *ceranoides* and *tenax*).

Distributional data listed below refer to recording units given in Seaward (1978, Fig. 1 and Table 1). They include additions to the flora made during the past three years, together with additions and corrections to former records provided mainly by Mr P. M. Earland-Bennett and Dr C. J. B. Hitch. We are grateful to these and other fieldworkers far too numerous to mention, and to Dr B. J. Coppins for his confirmation/identification of more critical material.

Acarospora fuscata (Nyl.) Arnold
Add Q.

A. smaragdula (Wahlenb.) Massal.
Add G.

Arthonia cf. *exilis* (Flörke) Anzi
Henderson, 1981. M. On shaded sandstone wall. (For a description of this plant, see Coppins (1983: p. 196), where it is listed as *Catillaria melanobola*.) 'It is not *A. exilis*; it is usually on basic bark, is rather common in Britain and is also known from Denmark' (B. J. Coppins, *in litt.*). First record of this genus in the conurbation; *A. spadicea* is known from just outside the conurbation's north-west boundary, at Hetchell Wood (44/3742; see Henderson, 1982).

Bacidia melaena (Nyl.) Zahlbr.
See *Micarea melaena* (Nyl.) Hedl.

Bacidia subfuscula (Nyl.) Th.Fr.
Earland-Bennett, 1976. E, M. On decayed moss, soil and stones of siliceous walls. Uncommon. Not dissimilar externally from the plant listed as *B.* sp. in Seaward (1978: p. 71), but having quite different spores. At Copley, Halifax, this plant is growing in a garden path on the vertical surface of a siltstone flag immediately below mortar. Two colonies occur in inner Leeds, one on the capstones of a millstone grit wall, Meanwood Ridge, the other on border edgestones in a nearby garden.

B. sp. (See Seaward, 1978: p. 71.)
Add M. Probably overlooked.

Cladonia chlorophaea (Flörke ex Sommerf.) Sprengel
Add S.

C. macilenta Hoffm.
Add E.

C. polydactyla (Flörke) Sprengel
Add W.

Evernia prunastri (L.) Ach.
Delete (U), add U. On dead stump in forestry plantation.

Hypogymnia physodes (L.) Nyl.
Add O. Gradual recolonization of suburbia (cf. Seaward, 1981, Fig. 2): several thalli on *Fraxinus* (44/1435, 44/2934, 44/2835, and 44/2836), and on single *Quercus* (44/267246) and *Ulmus* (44/291353), and on thin peaty soil over spoil heap (44/264247). See also under *Parmelia saxatilis*.

Lecania erysibe (Ach.) Mudd
Add D. The form *sorediata* is noticeably more numerous throughout the conurbation.

Lecanora albescens (Hoffm.) Branth & Rostrup
Bolton, 1775. (A), (G), M, (T), (V). On calcareous gravestone (44/2740). Uncommon.

L. atra (Huds.) Ach.
Add M.

L. dispersa (Pers.) Sommerf.
First record = Shackleton and Hebden, 1893.

L. muralis (Schreber) Rabenh.
Autecological studies of this species, based mainly on interpretations of its performance in the West Yorkshire conurbation, continue. Recent work has been concerned with recolonization following air pollution amelioration (Seaward, 1982).

L. saligna (Schrader) Zahlbr.
Add M.

L. stenotropa Nyl.
Add B. In some habitats forms of *L. polytropa* can resemble this species extremely closely in external characters. Microscopic examination of apothecia is frequently necessary to particularize field determinations.

Lecidella carpathica Körber
Earland-Bennett, 1974. G. On asbestos-cement roofing of Holmefield Barracks, now demolished. Possibly extinct.

Leptogium turgidum (Ach.) Crombie

Add U. First modern record: on decayed moss and soil in niches of old roadside wall. Rare. Several small colonies, including fruiting thalli, along 20 m stretch of wall at Farnley Hall (44/3147).

Micarea botryoides (Nyl.) Coppins

Add G, H. There is also a terricolous record of this plant growing amongst *Lepraria incana* at Danefield (44/2144).

M. melaena (Nyl.) Hedl.

Add B. Fruitless plants with black-stalked pycnidia, most probably referable to this species, occur occasionally on deeply shaded rock overhangs and vertical faces (e.g. in an overgrown derelict quarry near Bramhope, and on a large outcrop boulder, the Hollies, Leeds). 'There are, however, other species that produce such pycnidia, e.g. *M. botryoides* and *M. misella*' (B. J. Coppins, *in litt.*).

M. prasina Fr.

A mesoconidial state of this plant (with white pycnidia) has been found in woodland at Elland Park (44/1022), and at the Hollies, Leeds (44/2738). The microconidial and fruiting states occur quite frequently in the conurbation.

Mycoblastus sanguinarius (L.) Norman

Add M.

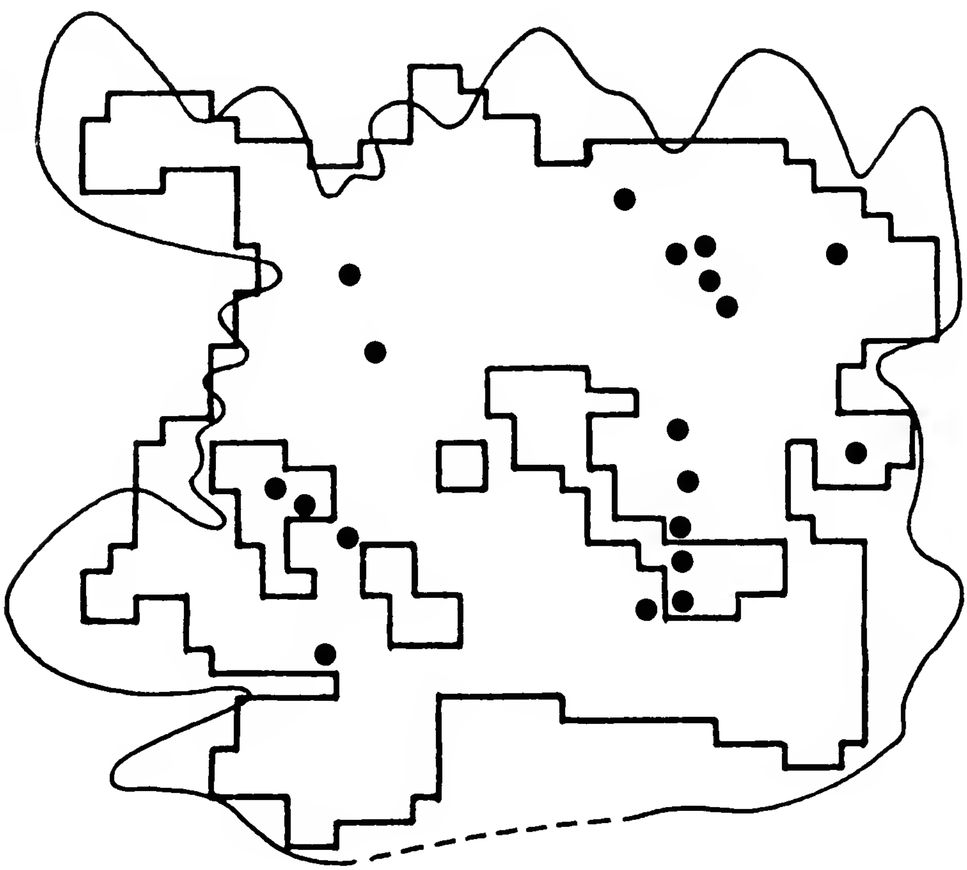

FIGURE 1

West Yorkshire conurbation: distribution of *Xanthoria parietina/aureola* showing major inner limit (equivalent to *c.* 70 μg/m^3 mean winter sulphur dioxide level) and disjunct recent sitings within the urbanized area. Each spot does not indicate merely isolated occurrences, but more extensive colonization reflecting the general invasive progress of these plants following atmospheric amelioration.

Parmelia glabratula (Lamy) Nyl.
subsp. *fuliginosa* (Fr. ex Duby) Laundon
Add M.

P. saxatilis (L.) Ach.
Add O. More frequent now on corticolous substrates (*Acer*, *Alnus*, *Fraxinus*, *Salix*, and *Ulmus*) on the edge of the conurbation (cf. Seaward, 1975, Fig. 28). With *Hypogymnia physodes* on *Fraxinus* at the inner Leeds sites mentioned above; rarely saxicolous in the same neighbourhood. When young or depauperate, difficult to differentiate from the next species.

P. sulcata Taylor
Several small thalli on single *Salix* (44/124382).

Peltigera spuria (Ach.) DC.
Add H. Undoubtedly the commonest member of the genus in the conurbation.

Phaeophyscia orbicularis (Necker) Moberg
Numerous further records from corticolous substrates, particularly *Acer*.

Physcia dubia (Hoffm.) Lettau
Add V.

Placynthium nigrum (Huds.) Gray
Add U. On stone of old roadside wall.

Ramalina farinacea (L.) Ach.
Interesting occurrence on millstone grit wall in an industrial area of central Halifax reported by Henderson and Stewart (1983).

Strangospora pinicola (Massal.) Körber
Add Q.

Thelidium incavatum Nyl. ex Mudd
Delete (T), add T. An isolated occurrence of this calciphile on petrified moss in the acidic surroundings of Ogden Clough, near Halifax (see Ackroyd, 1897; Henderson, 1983).

Trapelia coarctata (Sm.) Choisy
Add D. On the increase throughout the conurbation.

Verrucaria elaeomelaena (Massal.) Arnold
Add U. First modern record. Aquatic, on siliceous boulder in shaded woodland stream. Rare.

V. viridula (Schrader) Ach.
Add Q.

Xanthoria parietina (L.) Th. Fr.
Increasing number of reports of this species (including *X. aureola*) from within the conurbation (see Fig. 1).

As a consequence of this work, the lichen flora of the West Yorkshire conurbation can be summarized as follows: 322 lichen taxa have been reported from the area within 20 km of the centre of the conurbation, of which 5 are doubtful in the absence of supporting herbarium material, at least 32 are extinct in the area, and 185 have been recorded during the present survey (October 1967–December 1983).

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BOOK REVIEWS

The Ferns of Britain and Ireland by **C. N. Page.** Pp. xii + 447, with numerous b/w figures, maps, etc. Cambridge University Press. 1983. £40 hardback, £15 paperback.

Despite several editions of the very successful Hyde and Wade's *Welsh Ferns*, there has been no comprehensive treatment of the British pteridophytes as a whole this century. C. N. Page's book is therefore most welcome in that it provides a modern and highly informative text with detailed accounts of all species of British ferns and fern allies; hybrids are covered, but to a lesser extent.

Only two skeletal keys (chart and multi-access) are provided: identification data is therefore contained within the individual species accounts, which is only of help to those with a certain amount of prior taxonomic knowledge. The text description to each taxon contains detailed notes on identification, drawing attention to possible areas of confusion in identification, and excellent field notes, often based on personal observation.

Each taxon description is supplemented by a full page of frond silhouettes, a useful feature in that they show a range of variation, but sadly for the most part they are poorly reproduced (not necessarily the fault of the printer, since photocopies were used as originals). Each description is also provided with a small distribution map, but where the distribution is scattered or localized a larger scale map would have been more helpful, especially as some excellent maps showing environmental factors which influence native pteridophyte range are provided in the introductory matter. (Unfortunately the key to the atmospheric pollution map is reversed, and the map does not incorporate Irish data which is available.)

Other chapters and sections in the book contain: a taxonomic list of native species and hybrids, a glossary, botanical subdivisions of Britain and Ireland, altitudinal distribution of native pteridophytes, growing ferns from spores, conservation, further studies most needed, a bibliography (several citations in the text have been omitted), and an index, as well as the keys and environmental maps referred to above.

Despite the shortcomings described above, and the high price of the hardback edition, the wealth of information contained in the book will make it a most valuable aid for the botanist.

MRDS

Biology of Nonvascular Plants by **Hayden N. Pritchard** and **Patricia T. Bradt**. Pp. x + 550, with numerous line drawings and b/w plates. Times Mirror/Mosby College Publishing, St. Louis. 1984. £23.20.

For many years, there has been no adequate single account of nonvascular plants for college and university students, and it was necessary to consult numerous works to appreciate their range and diversity. Doyle's *Nonvascular Plants: Form and Function* (entitled *Nonseed Plants: Form and Function* in later editions) showed a breadth of study, but although an excellent introduction, did not provide the necessary depth, and in any case is now out of print. It is remarkable that two books filling this gap, that under review and *Nonvascular Plants: An Evolutionary Survey* by R. F. Scagel *et al*, should be published during the past two years; not only do they cover almost identical ground but they also treat their material in a similar manner and are published in a similar (typically American) format. (Furthermore, the recent new edition of Bell and Woodcock's *The Diversity of Green Plants* provides yet another alternative.)

A particularly good feature of Pritchard and Bradt's book are the sections on economic importance and ecology, which accompany their accounts of each major plant group. The work, which is well illustrated throughout, also contains selected references at the end of each chapter as well as a long list of cited literature (nearly 1000 items) and a useful glossary and index.

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Wild Orchids of Britain and Europe by **Paul Davies, Jenne Davies** and **Anthony Huxley**. Pp. xii + 256, plus 64 pages of full colour plates. Chatto & Windus. 1983. £9.95.

Consistently excellent colour photographs of each species (alas, without scales), complemented by clearly presented species descriptions, form the major part of this book; the descriptions, which also include details of flowering, habitat and distribution, are concise but highly informative. This part is preceded by interesting general accounts of morphology, pollination, development, and ecology, as well as a key to genera, and is followed by two sections on searching for and photographing orchids.

Under the section 'In search of orchids' the authors draw on their considerable knowledge gained from fieldwork throughout Europe to provide useful general guides to the orchids of Britain, western European countries, Scandinavia, Canary Islands, Madeira, the Mediterranean islands, Turkey, Syria, Lebanon, and Israel, but in order to thwart unscrupulous collectors exact locations of rare species have been omitted. In the case of Spain, one of the outstanding sites recommended (viz. Carratraca, p. 204) has sadly disappeared: the reviewer witnessed major roadworks here following the disastrous fires three years ago.

Despite numerous good orchid books on the market, this work can hold its own with the best of them. Thoroughly recommended to accompany amateur and professional botanists on their travels at home and abroad. MRDS

Dimensions of Darwinism: Themes & Counterthemes in Twentieth-Century Evolutionary Theory edited by **Marjorie Grene**. Pp. 336, including diagrams and tables. Cambridge University Press and Editions de la Maison des Sciences de L'Homme, Paris. 1983. £15.

The names of the twelve contributory essayists, Richard M. Burian; Stephen Jay Gould; Antoni Hoffman Wiejska; William C. Kilmer; Bernard Norton; D. S. Peters; William B. Provine; Wolf-Ernst Reif; Bernhard Rensch; Rupert Riedl; John Maynard Smith; John R. G. Turner ('biologists, historians and philosophers') are indicative of the quality of this book. The material originated from a conference held in Bad Homburg, West Germany, in 1981, on the topic of twentieth-century evolutionary theory. The book is divided into four parts with between two and four essays in each: Part I. The Developing Synthesis; Part II. Mimetic Theory: Its Relation to the History of Evolutionary Biology; Part III. The German Paleontological and Morphological Tradition; Part IV. Some Contemporary Issues: The Synthesis Reconsidered. The diversity of the work makes detailed comment difficult; Grene's thoughtful fifteen-page Introduction makes it largely superfluous. The book is well-produced and clearly laid out, and illustrates the diversity of evolutionary thought from the morphological 'metaphysic' of Riedl to the 'neo-Darwinian orthodoxy' of Maynard Smith. DJH

Spires of Form: Glimpses of Evolution by **Victor B. Scheffer** with drawings by **Gretchen Daiber**. Pp. viii + 152; illustrated in black and white. University of Washington Press, USA. 1983. £11.85.

Spires of Form is a book on animal evolution and natural history for the interested layman or young naturalist. Diversity, adaptation, resource partitioning, animal navigation, defence, sex, interspecific and intraspecific interactions, sociobiology, and the speed of evolution are among the topics presented briefly (e.g. sociobiology in forty-two lines), and often anecdotally: 'When I once visited Chitty at his laboratory in England he was weighing the tiny adrenal and thymus glands of field mice . . .'.

The illustrations, which include line drawings and photographs reproduced from various sources, share pages with the text; there are forty-two, serving a decorative rather than an informative function. A portrait of Charles Darwin, mandatory in popular books on evolution, occupies pride of place.

A bibliography for each chapter is provided under Reference Notes, and a list of thirty-one books with Scheffer's assessments and recommendations ('A pleasureful book'; 'For scholarly readers'; 'High-school or college undergraduate reading levels' . . ., etc.) is provided For Further Reading.

Bold headings within chapters and printers' embellishments compartmentalize the text, and make this a book easy to leaf through profitably in leisure moments. DJH

CHANGES IN THE STATUS OF THE STONECHAT IN THE SOUTH-WEST PENNINES DURING THE 1970s

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Introduction

Throughout the first seventy years of this century, the Stonechat *(Saxicola torquata)* was an uncommon species in the south-west Pennines. In the earlier part of the century, Parker (1928) reported only three passage records in twenty years in Rossendale, while Coward (1910) regarded it as a small-scale passage migrant and occasional breeding species in the hills of east Cheshire. The position was very similar in later years; Oakes and Battersby (1939), Oakes (1953), Bell (1962), and Spencer (1973). During the 1970s, there was a marked increase in the number of Stonechats recorded, at all seasons, in the Pennines and Pennine fringes of Lancashire and Greater Manchester (Wolstenholme, 1975; Spencer, 1978). The present paper examines this increase and the subsequent decline and briefly discusses some possible reasons for these changes in status.

The Study Area

This is depicted in Fig. 1 and includes the western Pennine hills between the rivers Ribble, in the north, and Mersey, in the south. Topographically, the area is very varied, with altitude ranging from 15 metres asl in the south-west corner up to 570 metres asl at Pendle Hill to the north of Burnley. It includes many large industrial towns and for approximately the last 150 years it has suffered the effects of relatively high levels of air pollution.

Methods

Stonechat records for the years 1971–79 inclusive were obtained from three types of source: (i) records published in the various county and local bird reports covering the study area; (ii) correspondence and discussion with many individual ornithologists in the area; and (iii) extensive field survey of known and likely breeding localities, particularly from 1977 onwards.

Results

The available records are plotted in Figs. 2, 3, 4, and 5 in which each rectangle represents the study area shown in Fig. 1.

Records on Fig. 2 are for April to September inclusive. This period spans the breeding season of the species in the study area but it may include a few passage birds, particularly in September. Fig. 3 includes all October and November records, this being the main period of autumn passage (Spencer, 1977). Fig. 4 shows all December and January records, which are here deemed to represent wintering individuals. Fig. 5 includes all records for February and March which, according to Spencer (1977), is the period of spring passage through the district. Some birds remained in one locality for parts of both the autumn and winter periods, as defined above; these birds are recorded on both Figs. 3 and 4. Likewise, some individuals are plotted on both Figs. 4 and 5.

April to September Records

Fig. 2 shows only occasional, mainly lowland, breeding before 1974 but then a rapid increase to a peak of seventeen confirmed breeding pairs in 1976. This level of population was maintained through the 1977 and 1978 breeding seasons, but there was a marked decline to only two confirmed breeding pairs in 1979. If the other birds recorded at this season are regarded as possible breeding birds, then the number of pairs possibly breeding in the study area rose to a peak of twenty-six in 1976. These figures are plotted in Fig. 6, which shows the same pattern for both the confirmed breeding and possible breeding curves. In view of the likely underestimation inherent in the survey methods used, the higher total of possible breeding pairs is considered to be a more realistic estimate of the population size.

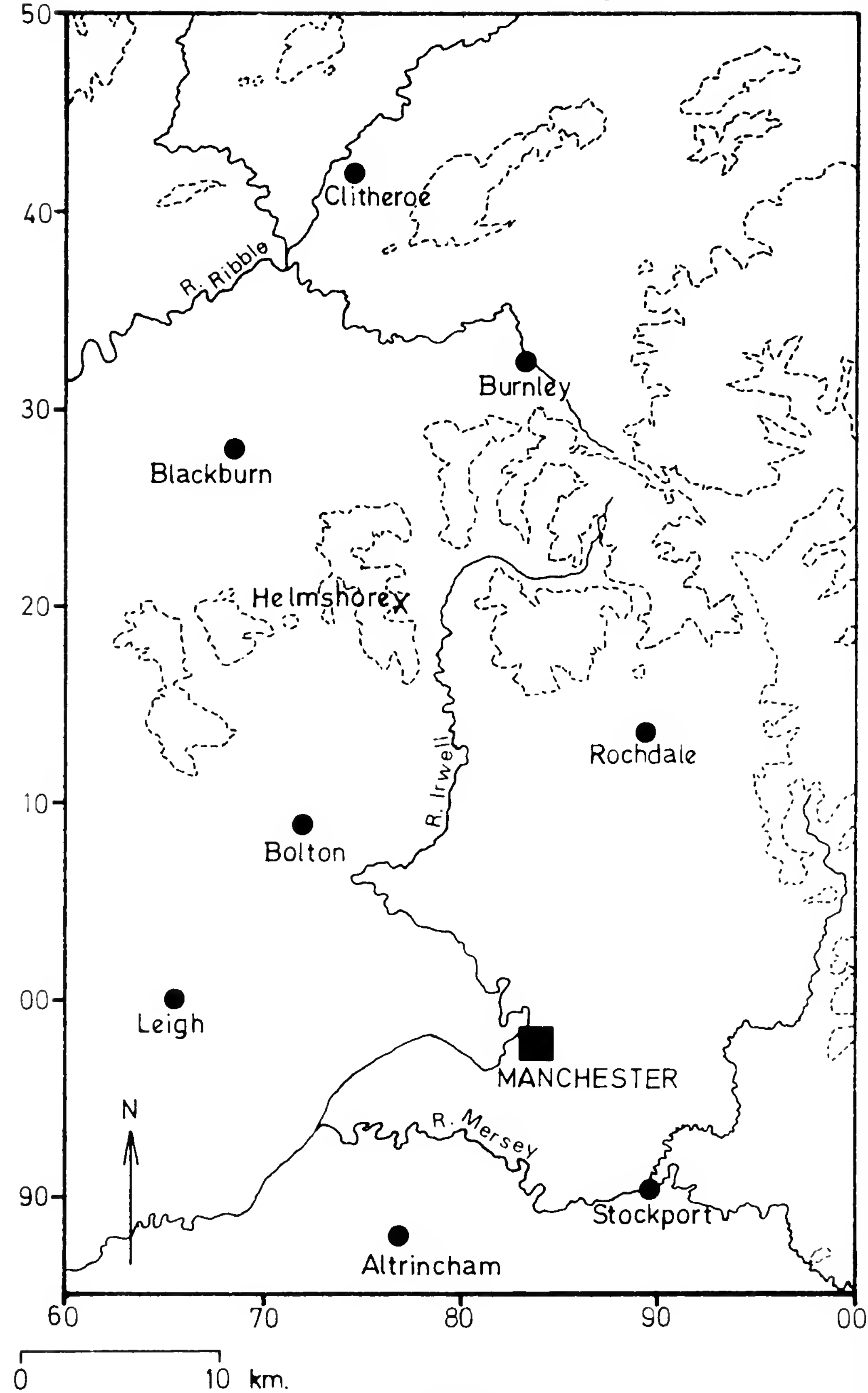

FIGURE 1
Map of the study area.

Comparison with Fig. 1 indicates an association of breeding records with the 305 metre (1000 ft) contour, with some concentration across the centre of the study area from Anglezarke Moor in the west to the Burnley, Rossendale and Rochdale hills in the east. This contrasts with the data for the whole of the British Isles, presented by Fuller and Glue (1977), which shows 91 per cent of Stonechat nests lying below 122 m (400 ft). Fuller and Glue also showed that, nationally, the related Whinchat *(Saxicola rubetra)* has a clear tendency to nest at higher altitudes than the Stonechat. Observations made during the present study, however, have repeatedly shown that where the two species are breeding in the same locality, the Stonechat is at a higher altitude than the Whinchat.

October and November Records

Fig. 3 shows an increase in records at this season from 1973; before the increase in breeding season records of 1974. There was then a steady increase in numbers to a peak in 1978, followed by a sharp decline in 1979, when the species reverted to its 1971 status at this season.

The records in Fig. 3 also show interesting variation in geographical pattern. In 1974, 1977 and 1978 there was a noticeable concentration of birds in the lower-lying south-west corner of the study area, particularly along the Mersey valley. In 1973, 1975 and 1976, however, this concentration was not apparent. In an area with so many active ornithologists, this difference is unlikely to be due to large changes in recording efficiency. Rather, it may represent the response of the dispersing Stonechat population to between-years variation in autumn food supply and availability in different parts of the study area. Further, Fig. 3 shows fewer autumn records in 1975 than in 1974, although there were approximately twice as many breeding season records in 1975 than in 1974. This seeming paradox can be similarly interpreted if the dispersing population in 1975 found much of its autumn food supply outside the study area. It may be significant in this connection that Frost (1978) noted over 100 reports of Stonechats in Derbyshire during the autumn and winter of 1975.

December and January Records

Fig. 4 shows a generally similar pattern of distribution to that given for October and November in Fig. 3. The increase in the number of winter records began, however, in 1972–73, a year before the autumn increase noted above and eighteen months before the 1974 increase in breeding season records (Fig. 2).

As in autumn, there is between-years variation in the distribution of winter records and it is particularly interesting that the cold winter of 1978–79 produced more records from the north-eastern half of the study area than any other winter during the 1970s, with the exception of 1976–77.

February and March Records

The records for these months are plotted in Fig. 5, which displays several points of difference from Figs. 2, 3 and 4. Firstly, the increase in numbers was not noticeable at this season until 1976; two years after the increase in breeding season records (Fig. 2) and three years after the winter increase (Fig. 4). Secondly, in all the years studied, except 1976, there was a distinct concentration of records in the western half of the study area. Thirdly, although there were fewer spring records in 1979 than in 1978, the number of 1979 records was not markedly lower

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FIGURES 2, 3, 4, and 5 (overleaf)

Location of Stonechat records within the study area. Each rectangle represents the study area shown in Fig. 1.

× confirmed breeding record
● male
◓ female
●◓ pair
○ sex not recorded.

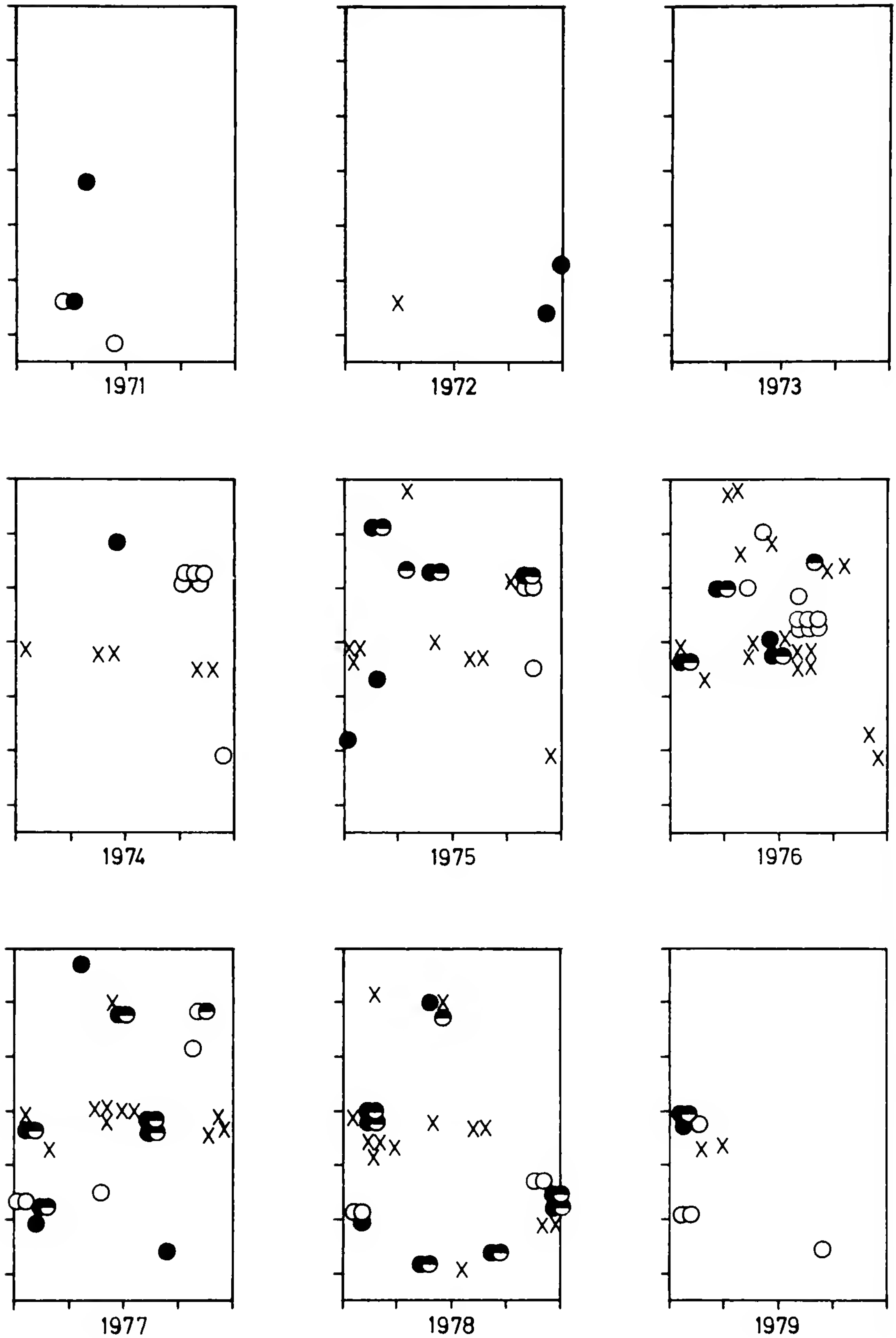

FIGURE 2
April to September

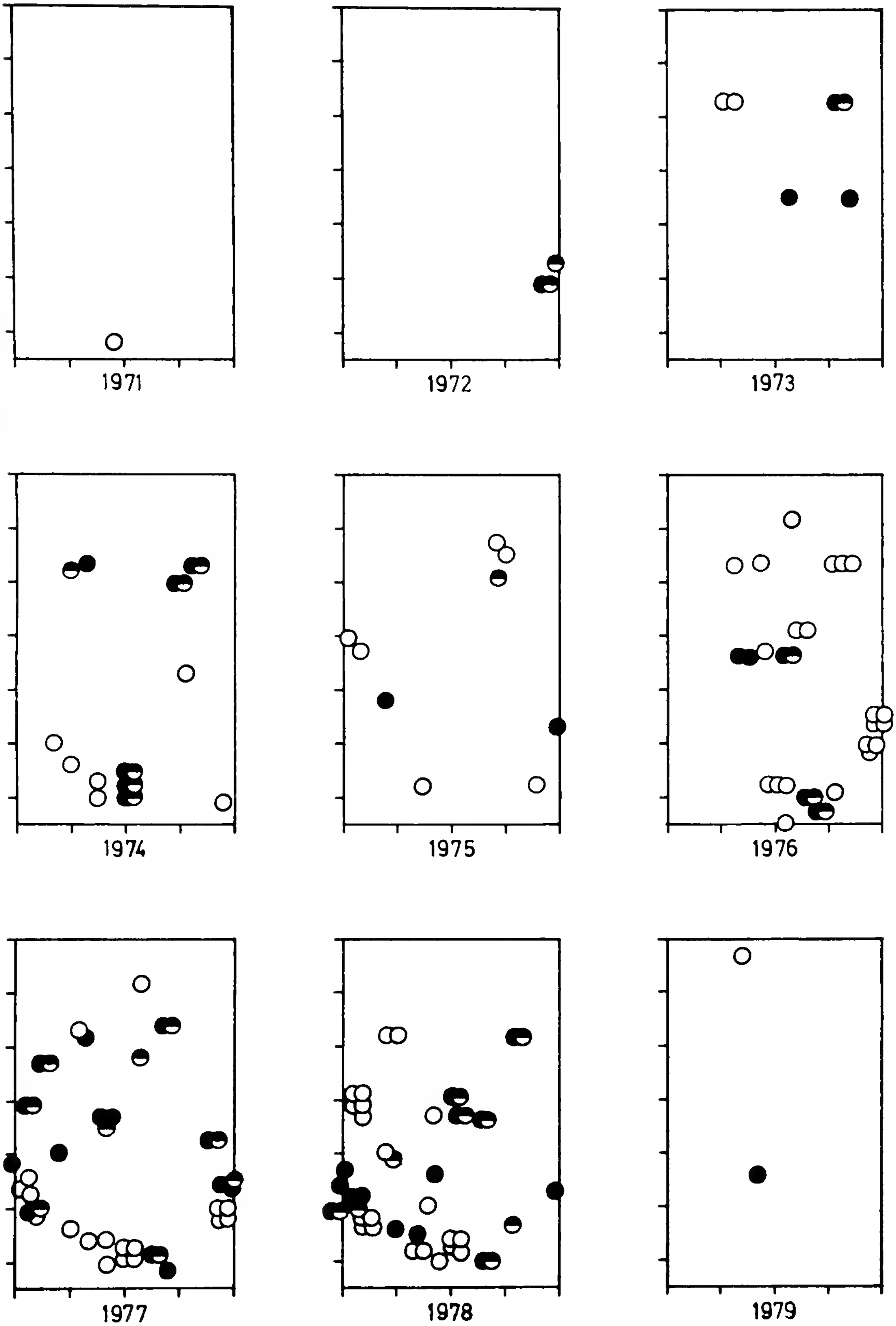

FIGURE 3
October and November

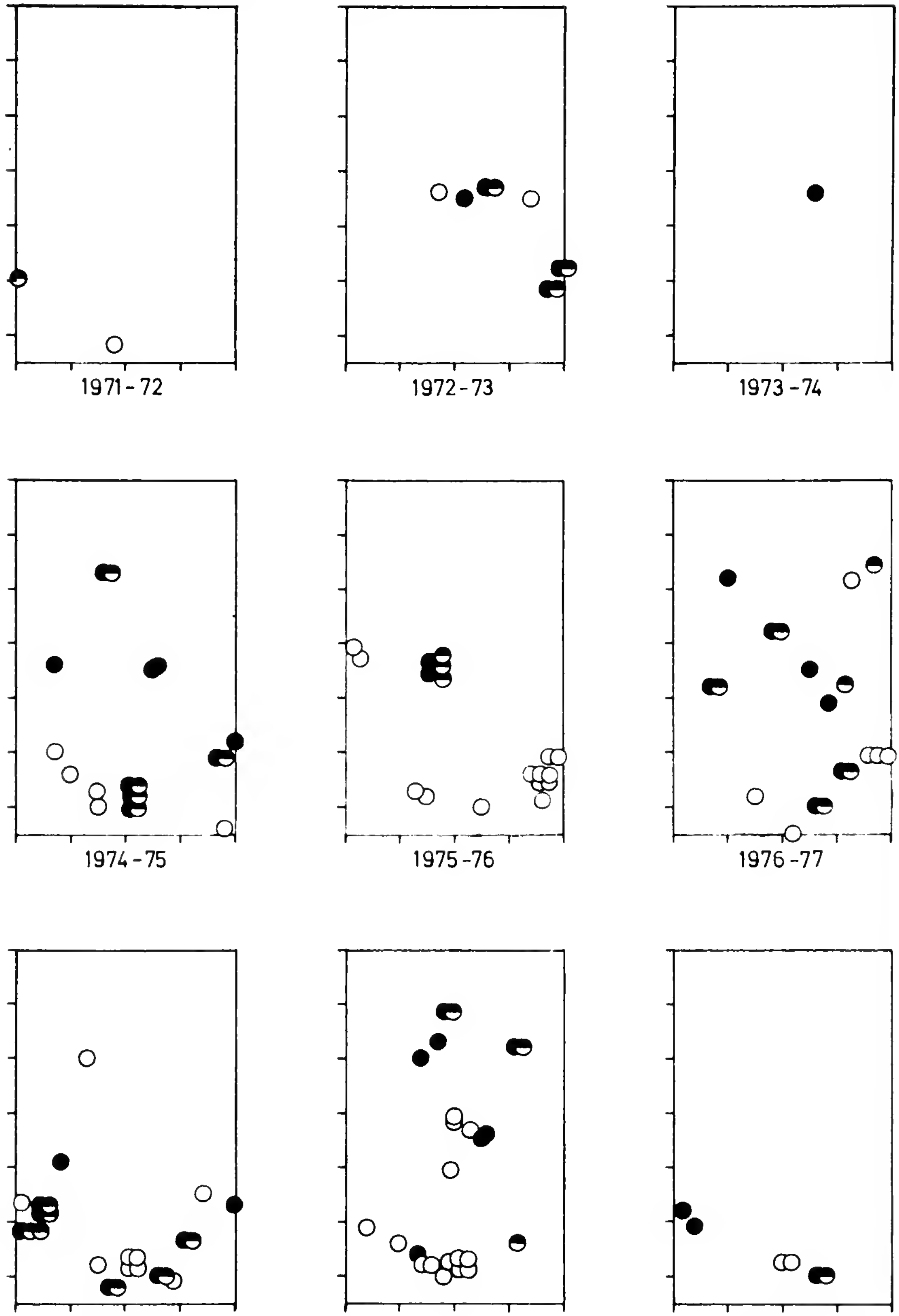

FIGURE 4
December and January

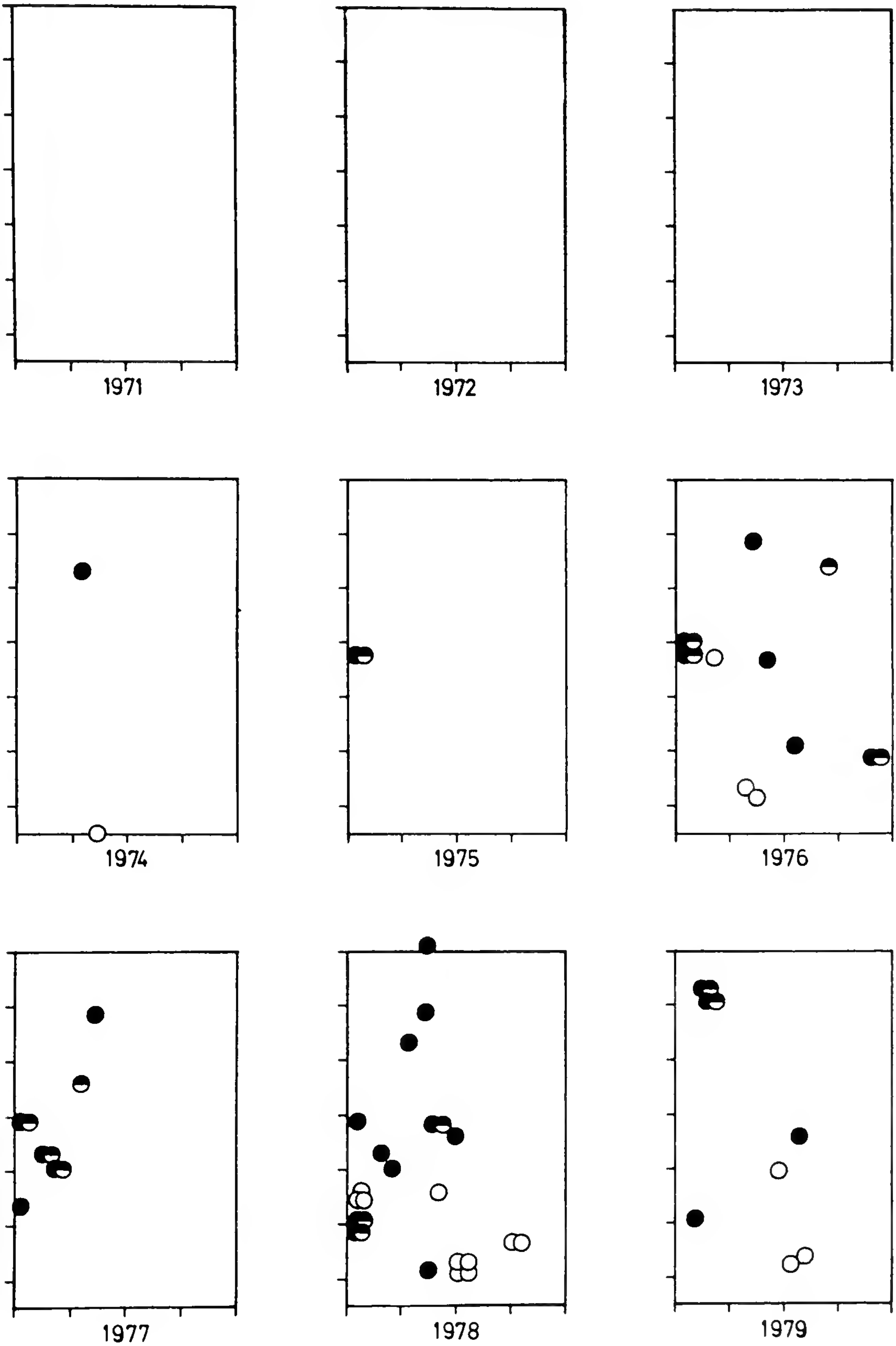

FIGURE 5
February and March

than any of the other years studied. There were, in fact, more February and March records in 1979 than in the same months of 1974 and 1975. This temporal pattern is in striking contrast to that shown for breeding season records in Fig. 2.

These observations tend to support the suggestion that most of the Stonechats recorded in the study area during February and March are true birds of passage and that most of the birds breeding in the study area do not return until later in the spring. Unfortunately, there is as yet no direct evidence on the movements of individual birds within the study area at different times of the year.

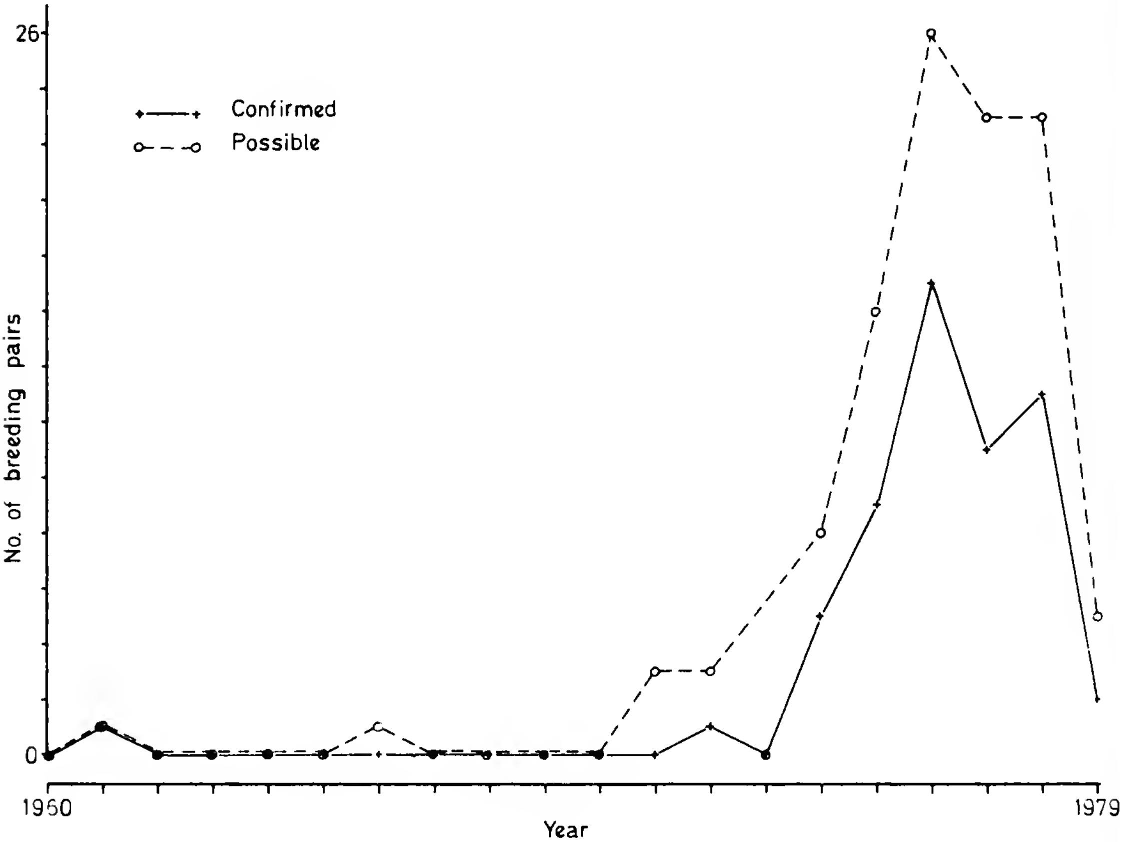

FIGURE 6

Numbers of confirmed and possible breeding pairs in the study area from 1960 to 1979.

Discussion

During the study period, autumn and winter increases in Stonechat numbers preceded breeding records. It is therefore possible that the breeding population developed from birds arriving in the study area during autumn and winter, whilst undertaking exploratory migration (Baker, 1978).

Direct evidence on the origins of these autumn and winter birds is very sparse but there are two relevant ringing recoveries:

> One bird was ringed as a first-year male on the Calf of Man on 14.9.67; it was found dead near Sale, Cheshire (GR SJ790930, see Fig. 1) on 3.11.68.
>
> The second was also ringed as a first-year male at Frodsham, Cheshire on 28.10.73 and was killed by a car at Belmont, north of Bolton (GR SD675155, see Fig. 1) on 7.12.74.

Available records indicate that the area has been used by such autumn and winter visitors for many years and it is pertinent to ask why a significant breeding population developed in the mid-1970s but not in other periods.

It has been demonstrated for several species, eg Great Tit *(Parus major)* (Perrins, 1979) that, at times of high population density, a breeding population tends to spill over into less-favourable habitat. If this applied to the present Stonechat study population, one would expect to have found significant increases in neighbouring, more-favourable, habitats by 1974. This does not seem to have been the case; rather, there were concurrent increases on the Lancashire coast (Spencer, 1976), in Cheshire and the Wirral (Raines, 1975) and on Walney Island (K. Parker, *pers.comm.*) at the same time as the study area population was increasing. In more distant areas, Stonechat populations also appear to have recovered gradually from the effects of the 1962–63 winter, so that the mid-1970s populations were similar to those breeding around 1960; eg in the Isle of Man (Cullen and Slinn, 1975), Cumbria (R. Stokoe, *pers.comm.*) and Bardsey Island (P. Roberts, *pers.comm.*). The overspill hypothesis is not, therefore, an entirely satisfactory explanation in this instance.

A second possibility is that, in the mid-1970s, Stonechats undertaking exploratory migration in autumn began to find favourable habitat in the previously unfavourable south-west Pennines. Consideration of environmental changes in the area at that time suggests two major factors which could be of importance to Stonechats reaching the area. The first and most widely reported of these factors is winter weather. It is well known that the Stonechat is among the species most severely affected by cold winters (eg Dobinson and Richards, 1964) and that a series of relatively mild winters often leads to an increase in its numbers. Fig. 7 shows the occurrence of mild winters at Manchester from 1877–78 to 1978–79 (G. Hughes, *pers.comm.*) and very cold winters in central England from 1860–61 to 1979–80 (Hughes, 1981). A mild winter is here defined as one with a mean temperature at least one standard deviation above the mean temperature of the period, whilst a very cold winter has a mean temperature at least one standard deviation below the mean for the period. Winter is taken to be the months of December, January and February.

During the 1970s, the three mild winters of 1973–74, 1974–75 and 1975–76 coincided with the large study area breeding population of 1974–78, although the records of wintering birds in 1972–73 are noteworthy in that they preceded this series of mild winters. The cold winter of 1978–79 is reflected in the greatly reduced breeding population of 1979. There were also comparatively few autumn and winter records in 1979–80, although the number of February and March (the spring passage season) records was not significantly lower in 1979. The decline in the breeding population has continued since 1979 and no pairs are known to have bred in the study area in either 1980 or 1981, even though the intervening winters were not cold. Thus, there has

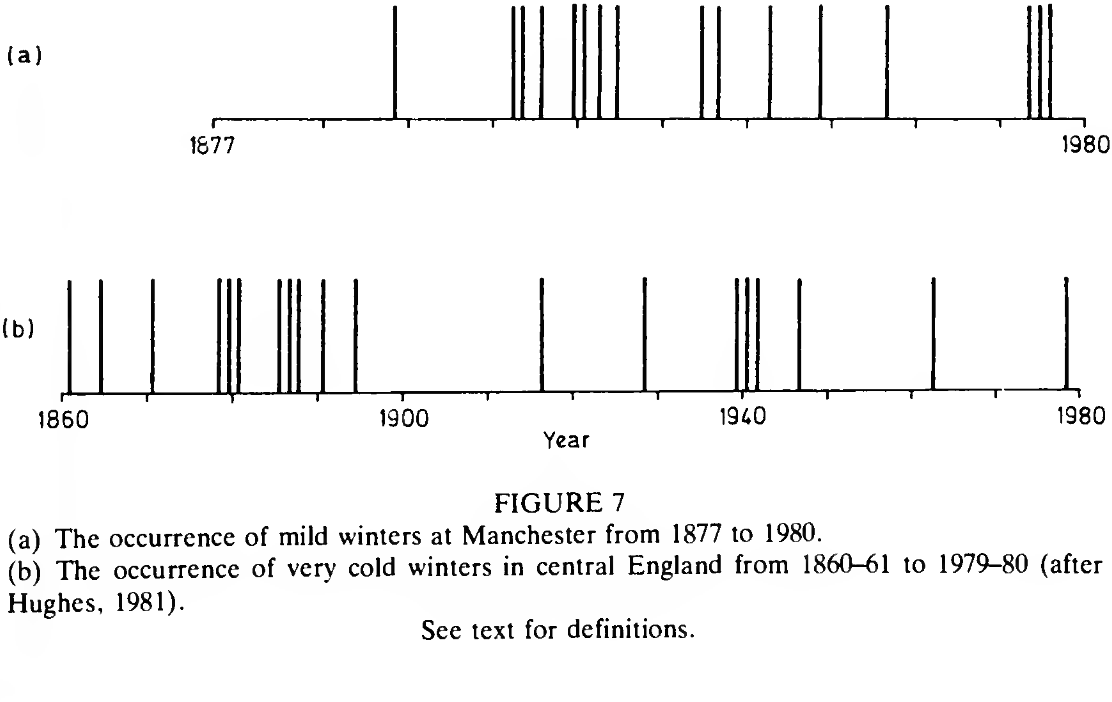

FIGURE 7

(a) The occurrence of mild winters at Manchester from 1877 to 1980.

(b) The occurrence of very cold winters in central England from 1860–61 to 1979–80 (after Hughes, 1981).

See text for definitions.

been some general correlation with winter weather during the 1970s but the relationship is evidently complex.

It is apparent from Fig. 7 that series of mild winters generally comparable to that of the mid-1970s occurred in 1912–16, 1919–25 and 1934–37. On the whole, the period 1910 to 1939 was a very mild spell with long gaps between cold winters comparable to, but much longer than, that of the mid-1970s (G. Hughes, *pers.comm.*). It is striking, therefore, that Oakes and Battersby (1939) could only describe the Stonechat as 'a very scarce resident . . . (which) nests sparingly on Pendle . . . but has never been known to nest in Rossendale'. Additional factors, besides winter weather, are clearly implicated in determining the numbers of Stonechats in the study area.

The second major factor to be considered here is atmospheric pollution. Savidge (1963) showed that smoke and other particulate air pollution had depressed the annual sunshine total in South Lancashire by up to 15 per cent in the period 1921–50, as well as helping to form and prolong fogs. He also gave pH values for rainwater in the study area; these ranged from 3.7 to 5.0 in winter and from 4.5 to 6.0 in summer. Such factors have often been associated with impoverishment of the area's flora and fauna in the post-Industrial Revolution period (Pennington, 1974; Wood *et al*, 1974).

Fig. 8 shows the annual monthly mean concentrations of smoke and sulphur dioxide in the air from 1953 to 1979 at Helmshore, Rossendale, which is approximately in the centre of the study area (Fig. 1). During this period, smoke concentration declined by some 90 per cent and sulphur dioxide concentration declined by 60 per cent. It is reasonable, therefore, to expect a consequent increase in biotic diversity in the area and it is suggested that the marked increase in the Stonechat population of the mid-1970s may be part of this wider increase, due at least in part to the habitat becoming more favourable, probably in terms of food supply. It is interesting to

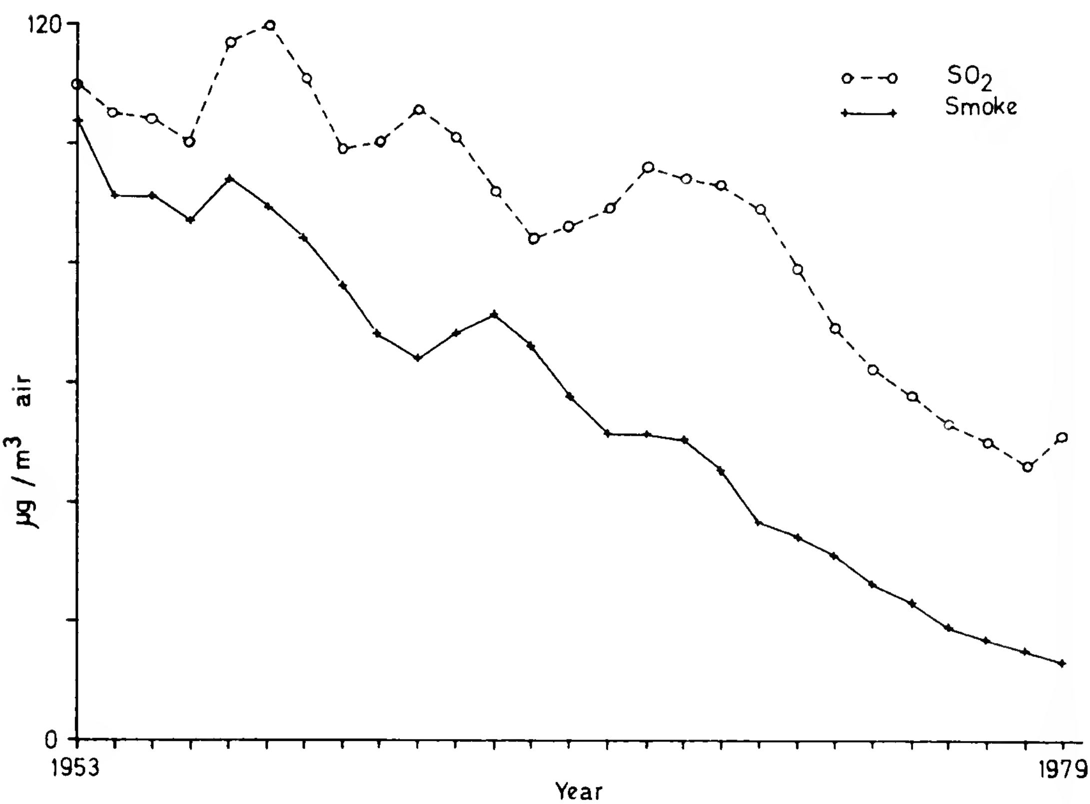

FIGURE 8
Annual monthly mean concentrations of smoke (particulatc mattcr) and sulphur dioxidc in thc air at Helmshore, Rosscndale (scc Fig. 1) from 1953 to1979 (smoothcd progrcssions).

observe in this connection that Blackwall (1824) regarded the Stonechat as a reasonably common 'summer bird' around the north-eastern fringes of Manchester; whilst Davenport (1872) records that the species 'used to be plentiful around Middleton, but is now rare'. Some of this decline was doubtless due to habitat loss with the rapid contemporary development of industrial towns but it seems likely that atmospheric pollution was also a cause.

It is concluded that the numerical changes observed in this Stonechat population during the 1970s are the resultant of a matrix of environmental gradients, of which winter weather and atmospheric pollution are major elements. The more detailed relationships involved are currently being investigated and the results will be reported in due course.

Acknowledgements

Thanks are due to the many ornithologists who generously supplied details of their Stonechat records, and particularly to N. Burke and D. Brooks who accompanied me on many hours of fieldwork. I am also grateful to G. H. Hughes for assistance with weather data and to staff of the former Great House Experimental Husbandry Farm for the Helmshore air pollution data. Permission to use the relevant ringing data was kindly given by the British Trust for Ornithology.

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FIELD NOTES

Brambling feeding on peanuts

On 23 January 1984, a female Brambling *(Fringilla montifringilla)* visited my garden at Scalby, on the outskirts of Scarborough. This is the first I have seen in the garden during the thirteen years I have lived in this house. Perhaps it was not so unexpected in view of the weather conditions prevailing, as I heard of Bramblings being seen then in two other gardens, a male in Scarborough and a small flock of seven in Filey.

The bird I saw in my garden visited the bird table and showed itself quite capable of clinging to the peanut basket and extracting food through the wire. On several occasions it pulled peanuts out of the basket and took them onto the ground to eat.

In *The Garden Bird Book*, edited by David Glue (1982, p. 114) it is stated that 'In recent years a few Chaffinches and Bramblings appear to have learnt that food may be obtained from hanging containers, but their attempts to emulate the Greenfinch and Tits have met with limited success.'

So far the only Chaffinch *(Fringilla coelebs)* I have seen was successful in clinging to a feeding basket and obtaining food from it. This was in a garden in Baysdale, North Yorkshire. It would be of interest to learn of other incidents of successful feeding in this way by these two species.

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Unusual feeding behaviour by a Kingfisher

From 28 August to 31 October 1983 a Kingfisher *(Alcedo atthis)* used the ridge of a greenhouse at Rudston, near Driffield, North Humberside, as a vantage point from which to feed. The greenhouse is some 50 yards from the Gypsy Race, a small stream which passes through the village.

The owner of the greenhouse noticed that the bird was present at dawn each day, and was there when he left home to go to work at 08.00. It was still present on the greenhouse each evening when he returned home, and at weekends the bird was seen to be present for the greater part of the day, staying until darkness made further observation impossible.

During daylight observations the bird was seen to take insects from the greenhouse roof at regular intervals; occasionally it flew to the lounge window of the house, alighting on the window ledge, where it could be easily observed feeding on spiders, beetles, flies and moths. On one occasion the Kingfisher was seen to hover at several points along the house wall, and to pick insects off the wall surface.

Moths were eaten in the same manner as that adopted by Spotted Flycatchers *(Muscipapa striata)*, the insect held lengthways in the bill, the wings nipped off, and the body swallowed whole. Other prey was apparently eaten whole.

Moth wings collected from the ground below the window ledge enabled identification of three species, Beaded Chestnut *(Agrochola lychnidis)*, Brown Spot Pinion *(Anchoscelis litura)* and Angle Shades *(Phlogophora meticulosa)*.

This unusual Kingfisher feeding behaviour was seen by myself and others. I have been unable to trace any other record of similar feeding behaviour by this species.

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A preliminary note on the distribution of larval Trichoptera in the Huddersfield Narrow Canal

Several recent publications have included records of the invertebrate fauna and macrophytic flora of the Huddersfield Narrow Canal (see Ormerod and Morphy, 1983; *Naturalist* **108**: 85–92). The following is a brief account of the distribution in the canal of larval Trichoptera from systematic surveys undertaken in 1979 and 1980 by kick/sweep sampling and Eckman grab. Trichopteran records from Ormerod and Morphy *(op. cit.)* have been included following more detailed taxonomy and examination of voucher specimens by Dr P. D. Hiley and R. A. Jenkins, to whom we are grateful. The numbers after each species refer to occurrence at stations given in Watkin and Morphy (*Naturalist* **101**: 19–25).

Rhyacophila dorsalis (Curt.) On cascaded locks between 29 and 39.
Polycentropus flavomaculatus (Pict.) Near 34.
Holocentropus dubius (Ramb.) Near 34.
Cyrnus trimaculatus (Curt.) At 1 and 55.
Lype reducta (Hag.) At 29 amongst *Typha*. This species has been regarded as rare, though it is common in south and mid-Wales (R. A. Jenkins, pers. comm. Ormerod unpubl.).
Hydropsyche angustipennis (Curt.) On cascaded locks between 29 and 39 and in a shallow run at 37.
Phryganea (Agrypnia) obsoleta Hag. 1–22 and 55.
Limnephilus rhombicus (L.) 1–37.
L. lunatus Curt. 3–38 and 55.
Halesus radiatus/digitatus Steph. 11–33.
Molanna angustata Curt. 2–23.
Mystacides azurea (L.) 19.
Goera pilosa (Fabr.) 11–19.

Whilst the list is far from complete, some interesting aspects of distribution are apparent, with the reaches of the canal downstream of Milnsbridge generally producing few or no species. It is hoped a fuller account will be given elsewhere (Higgins/Morphy in prep.).

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BOOK REVIEWS

Seashore Life of the Northern Pacific Coast, An Illustrated Guide to Northern California, Oregon, Washington and British Columbia by **Eugene N. Kazloff**. Pp. 370, 299 colour illustrations on 40 plates, plus nearly 400 black and white photographs and line drawings. Washington University Press. 1983. £34 cloth, £16.95 paperback.

The area covered by this book is very extensive and therefore it can only cover a percentage of the animals and plants found on this part of the west coast of America. The author has divided the book into specific coastal habitats such as Rocky Shores, Sandy Beaches, Quiet Bays, and Salt Marshes, and covers the animals and plants found in each of these situations. Although this book covers species found on the Pacific Coast it is quite surprising how many occur on the British list. These range from the small and local Sacoglossan *Alderia modesta* to the very common lichens *Xanthoria candelaria* and *Physcia caesia*. The illustrations on the whole are very good, whilst the text is concise and informative.

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Collins Handguide to the Birds of New Zealand written and painted by **Chlöe Talbot Kelly** (designed by Herman Heinzel). Pp. 127. Collins: Auckland, Sydney, London. 1982. £4.95.

In 1978 Collins (Auckland, London) brought out *The New Guide to the Birds of New Zealand* by Falla, Sibson and Turbott, which immediately established itself as the bible for ornithologists in that country. This modest new guide by Kelly in no way seeks to challenge its predecessor's position, but serves rather as both useful introduction and handy pocketbook for the birdwatcher in those remote fields. Clearly arranged, with text and illustrations on the same or facing pages, it is far easier to use in a Wellington gale or a Cook Straits swell, and its illustrations stand out clearly — sometimes perhaps too clearly. The colouring is occasionally too garish, and diagnostic features over-emphasized. A few errors in the illustrations need correction (e.g. the dark patch on the lower mandible of the Chatham Island Mollymawk has been omitted). The text gives brief but clear and accurate information on the 230-plus species illustrated. The taxonomy and nomenclature of some New Zealand birds are still problems without universally agreed solutions; Kelly (like other New Zealanders, unlike Australians) keeps the term Mollymawk for smaller species of Albatross, and recognizes only two native species of Oystercatcher (with Black a variant form of Variable).

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